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ALASKA

VOLUME XI

SMITHSONIAN INSTITUTION

HARRIMAN ALASKA SERIES

VOLUME XI

NEMERTEANS

BY

WESLEY R. COE

BRYOZOANS

BY

ALICE ROBERTSON



(PUBLICATION 1998)

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SMITHSONIAN INSTITUTION,

WASHINGTON, D. C., JULY, 1910

HARRIMAN ALASKA EXPEDITION
WITH COOPERATION OF WASHINGTON ACADEMY OF SCIENCES

ALASKA

VOLUME XI

NEMERTEANS

BY WESLEY R. COE

BRYOZOANS

BY ALICE ROBERTSON



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PREFACE

THIS volume contains three papers: two on Nemerteans, by Dr. Wesley R. Coe, Assistant Professor of Comparative Anatomy at Yale University, and one on Bryozoa, by Miss Alice Robertson, of the University of California. Doctor Coe's first paper is based on the Nemerteans collected by the Harriman Expedition, mainly by the author himself, and was published in the Proceedings of the Washington Academy of Sciences in March, 1901; the second, which embraces additional species, including those from the coast of California, is here published for the first time. Owing to the very thorough manner in which these animals are treated, the present volume is sure to be a valued contribution to the knowledge of a little known group.

C. HART MERRIAM,
Editor.

WASHINGTON, D. C.
December 24, 1903.

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NEMERTEANS OF THE PACIFIC
COAST OF NORTH AMERICA

PART I

The present paper was originally published in the Proceedings of the Washington Academy of Sciences, vol. III, pp. 1-110, March 26, 1901. It is here reprinted from the same electrotypes plates, so that it may be quoted exactly as if it were the original. The original pagination is the same as that of the present volume; the original numbers of the plates are also the same as in the present volume, so that no change has been necessary. The running plate caption has been changed from Proceedings of the Washington Academy of Sciences, vol. III, to H. A. E., vol. XI. No other alterations of any kind have been made, save the introduction of the illustration at the top of the first page, in place of the running heading of the Academy's Proceedings, and the change of the title, which was: *Papers from the Harriman Alaska Expedition. xx. The Nemerteans.*

The author desires to record the following corrections and additions :
 Page 3. A summary of the contents of a posthumous paper by Mr. B. B. Griffin on the Nemerteans of Puget Sound and Alaska is given on pages 114-118 of Part II. This paper antedates Part I of the present report and necessitates the following changes in nomenclature :

"*Carinella speciosa* sp. nov." should read *Carinella rubra* Griffin; pp. 5, 7 11-14.

"*Carinella dinema* sp. nov." should read *Carinella sexlineata* Griffin; pp. 5, 8, 15, 16, 17.

"*Carinoma griffini* sp. nov." should read *Carinoma mutabilis* Griffin; pp. 5, 8, 20-23.

"*Amphiporus leuciodus* sp. nov." should read *Amphiporus imparispinosus* Griffin; pp. 6, 9, 31, 51-53, 55.

"*Amphiporus exilis* sp. nov." should read *Amphiporus formidabilis* Griffin; pp. 6, 51-56.

Page 8, third line from top, after "surface" add: *while a sixth longitudinal line is often indicated along the mid-ventral surface.*

Page 34, at end of second paragraph add: *Stylets are spirally fluted, and appear as if braided.* See footnote, p. 144.

Page 55, at end of last paragraph add: *except in Geonemertes, where Böhmig (Zeits. f. wiss. Zool., lxiv, p. 34, 1898) has found 8 or 9 nephridiopores above and 1 or 2 below the lateral nerves.*

Page 82, add: *Further notes on coloration and distribution of Cerebratulus albifrons are given in Part II, p. 200.*

EDITOR.



THE NEMERTEANS OF THE EXPEDITION

BY WESLEY R. COE, PH.D.

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THE Harriman Alaska Expedition, during the months of June and July, 1899, afforded exceptional advantages for the investigation and collection of the marine invertebrate fauna of the Alaska coast south of Bering Sea.

During the course of the expedition collections of Nemer-teans were made at Victoria (Vancouver Island) and Lowe In-let in British Columbia; at New Metlakahtla (Annette Island), Cape Fox, Wrangell, Farragut Bay, Taku Harbor, Juneau, Skagway, Glacier Bay, Sitka, and Hot Springs on the islands and mainland of southeastern Alaska; at Russell Fiord and Yakutat Bay; at Orca and Virgin Bay in Prince William Sound; at Kadiak; at Popof Island, Shumagin group; at Kukak Bay on the Alaska Peninsula; and at Dutch Harbor, Unalaska.

Stops were made also on St. Paul, St. Matthew, and Hall Islands in Bering Sea; at Plover Bay, Siberia, and at Port Clarence, Alaska, just south of Bering Strait. At these latter localities, however, the shores are surrounded in winter by pack ice, which prevents the existence of any considerable amount of life between tides. No Nemerteans were found here between tides in the limited time at our command, though it is not unlikely that in deeper water an abundance of these worms could have been obtained by the dredge. South of Bering Sea, on the other hand, the shores are densely covered nearly to high water mark with a luxuriant growth of nearly all classes of invertebrates.

All along that part of the coast which borders the North Pacific Ocean—from Dixon Entrance to the Aleutian Islands—with the exception of areas subject to local disturbing elements, such as the proximity of rivers and glaciers, invertebrates occur in remarkable abundance. Not only is there an enormous number of individuals, but also a great variety of species. And, furthermore, the unusually large size which many of the species attain is quite as striking as the wealth of species and individuals. The purity of the water, its freedom from contamination from muddy streams, and the great rise and fall of the tides with their consequent swift currents, which continuously provide a rapidly changing supply of pure water, furnish conditions especially favorable to the growth of marine invertebrate animals.

Exceptions to these favorable conditions were found at Juneau, where the water is of slightly less than normal density, and contains a considerable amount of sediment. At Skagway these unfavorable conditions are still more pronounced, and here very few Nemerteans could be found between tides. In Russell Fiord the water was decidedly brackish, there was little tide, and almost no shore collecting could be done. Localities in the vicinity of glacier fronts were extremely barren of marine life, as was to be expected.

Perhaps the locality which proved the most fruitful was Dutch Harbor, Unalaska, although the stations in Prince William Sound were but little inferior, and Sitka was found to possess an extremely rich littoral fauna.

Of the abundance of Nemerteans collected, colored drawings were made of most of the species, and many specimens were carefully preserved for anatomical study, and have proved most interesting. Serial sections of most of the species have been prepared, and details of their anatomy will be found on subsequent pages.

Two other members of the expedition, Prof. William E. Ritter, of the University of California, and Prof. Trevor Kincaid, of the University of Washington, have generously submitted to me the Nemerteans collected by them.

SPECIES PREVIOUSLY RECORDED.

The Nemertean fauna of the northwest coast of North America up to the present time has been almost entirely neglected. Several small collections have been made, but the only literature relating to the group in this region seems to be a paper by Stimpson. This author¹ gives brief Latin diagnoses of the following species from the west coast of North America:

Emplectonema viride Stimpson [= *Nemertes gracilis* Johnston = *Emplectonema gracilis* Verrill]. Found by Stimpson under stones between tides in San Francisco harbor. This species occurs abundantly along the whole Pacific coast of Alaska.

Cosmocephala beringiana Stimpson [= *Amphiporus angulatus*]. Found in Bering Strait in five fathoms. This species also is abundant along the whole Pacific coast of Alaska.

Cerebratulus impressus Stimpson [= *Micrura impressa*]. Found in twenty fathoms in Bering Strait. This species was not met with by the Harriman Expedition.

The investigation of the systematic position and anatomy of this group of worms has been rendered much less difficult since the publication of Bürger's excellent monograph on the Nemerteans of the Gulf of Naples.² Bürger's classification is found to be admirable, and his nomenclature has been closely followed in the present work. It will be impossible, however, to retain the generic names *Eunemertes* and *Eupolia* which Bürger adopts, for the reason that they have been antedated by Stimpson. In

¹ Proc. Acad. Nat. Sci. Philadelphia, pp. 159-165, 1857.

² Fauna und Flora des Golfes von Neapel. Monogr., 22, 1895.

1857 Stimpson¹ published brief, though accurate, diagnoses of these same genera under the names *Emplectonema* and *Tæniosoma*. Moreover, Stimpson gives as the type of *Emplectonema*, *E. camillea* [= *Borlasia camillea* Quatr. (1846) = *Amphiporus neesii* Oersted (1844) = *Eunemertes neesii* Vaillant (1890)]. Not only this species, but also Stimpson's other species, *Emplectonema viride* [= *Nemertes gracilis* Johnston, 1837], is a typical member of the genus named by Vaillant more than thirty years later. With these facts in mind it is obvious, as has been already pointed out by Verrill,² that Stimpson's name must be retained.

The status in regard to *Eupolia* Hubrecht (1887) is similar. Stimpson named *Borlasia quinquelineata* Quoy et Gaimard (1833) as belonging to his new genus *Tæniosoma*, and described as new species *T. septemlineatum* and *T. æquale*, which is probably identical with *quinquelineatum* Quoy et Gaimard. But both of these species are typical of *Eupolia* Hubrecht. There can be no doubt, therefore, about the identity of the two genera³ and, as in the case of *Emplectonema*, Stimpson's name, *Tæniosoma*, must hold.

The brevity of some of Stimpson's *generic* diagnoses, as mentioned above, is justified by the citation of well known typical species of those genera, and in such cases their validity cannot be questioned. Of his *specific* descriptions, on the other hand, it is more than likely that some will prove insufficient for an indisputable determination of the species.

In the preservation of the Nemerteans, I found a 2- to 5-percent solution of formalin in sea-water to yield most satisfactory results. Most forms die well-extended if a few drops of formalin are added to the water in the vessel in which the living worms are contained. The formalin solution preserves the general anatomical and some of the histological features excellently, and sharp nuclear stains are easily secured, especially with the epithelial structures. This solution, however, works

¹Proc. Acad. Nat. Sci. Philadelphia, 1857.

²Trans. Connecticut Acad., VIII, p. 413, 1892; *ibid.*, IX, p. 146, 1895.

³Bürger states distinctly in his great Monograph (p. 26) that "*Tæniosoma* deckt sich mit *Eupolia*," but, for some reason, does not consider Stimpson's diagnoses valid.

havoc with the nervous elements and with the connective tissues. Specimens killed in strong alcohol proved valuable adjuncts to the formalin preparations. In most cases the formalin specimens have been eventually transferred to alcohol for permanent preservation. Corrosive sublimate-acetic, Gilson's fluid, and, for nervous elements, Flemming's solution are always to be recommended.

For serial sections no stains have given more happy results than Delafield's hæmatoxylin, followed by Orange G.

In the limited time at our disposal it was naturally impossible to make an exhaustive collection or study of the Nemertean fauna. Some thirty-two species were collected, however, and of these twenty-seven proved to be new to science, and only two of the remaining species have been recorded from the Pacific.

LIST OF SPECIES HERE RECOGNIZED.

Following is a list of the species recognized, with brief notes on their general distribution so far as our collections go:

PROTONEMERTEA.

1. *Carinella speciosa* sp. nov. Along the whole Pacific coast of Alaska. Vancouver Island (Shearer). Not uncommon.
2. *C. dinema* sp. nov. Victoria, B. C.; Sitka. Uncommon.
3. *C. capistrata* sp. nov. Prince William Sound. Common.

MESONEMERTEA.

4. *Cephalothrix linearis* (Rathke) Oersted. Pacific coast. Abundant.
5. *Carinoma griffini* sp. nov. Collected by Mr. Creswell Shearer at Albert Head, Vancouver Island.

METANEMERTEA.

6. *Emplectonema gracile* (Johnston) Verrill. Pacific coast. Abundant. San Francisco (Stimpson).
7. *E. bürgeri* sp. nov. Glacier Bay; Sitka. Not common.
8. *Zygonemertes thalassina* sp. nov. Sitka. Not uncommon.
9. *Z. albida* sp. nov. Victoria, B. C. Uncommon.
10. *Paranemertes peregrina* gen. et sp. nov. Pacific coast. Vancouver Island (Shearer). Abundant.
11. *P. pallida* sp. nov. Yakutat Bay; Popof Island. Uncommon.

12. *P. carnea* sp. nov. Pacific coast. Vancouver Island (Shearer). Common.
13. *Amphiporus angulatus* (Fabricius) Verrill. Pacific coast. Abundant.
14. *A. bimaculatus* sp. nov. Southeast coast. Uncommon. Puget Sound (T. Kincaid).
15. *A. tigrinus* sp. nov. Farragut Bay. Uncommon.
16. *A. nebulosus* sp. nov. Kukak Bay, Alaska Peninsula. Uncommon.
17. *A. leuciodus* sp. nov. Southeast coast. Common.
18. *A. exilis* sp. nov. Pacific coast. Abundant.
19. *Tetrastemma bicolor* sp. nov. Kadiak. Not common.
20. *T. aberrans* sp. nov. Glacier Bay; Prince William Sound. Uncommon.
21. *T. cæcum* sp. nov. Dredged by Dr. Ritter at Kadiak. Common.

HETERONEMERTEA.

22. *Tæniosoma princeps* sp. nov. Southeast coast. Uncommon.
23. *Lineus viridis* (Fabricius) Verrill. Annette Island. Common.
24. *L. torquatus* sp. nov. Prince William Sound. Common.
25. *Micrura verrilli* sp. nov. Prince William Sound. Not uncommon.
26. *M. alaskensis* sp. nov. Southeast coast. Common.
27. *Cerebratulus herculeus* sp. nov. Sitka. Not uncommon.
28. *C. marginatus* Renier. Sitka. Not uncommon.
29. *C. occidentalis* sp. nov. Yakutat; Prince William Sound. Vancouver Island (Shearer). Abundant.
30. *C. longiceps* sp. nov. Yakutat. Uncommon.
31. *C. montgomeryi* sp. nov. Puget Sound to Unalaska Island. Common.
32. *C. albifrons* sp. nov. Near Sitka. One specimen.

It must be remembered that the above list represents but a few weeks' collecting, and sometimes with only a few hours at a locality; too much confidence therefore should not be placed on the distribution or comparative abundance of the various species. Further research will undoubtedly add greatly to the number of species, and judging from the number found in so short a time it seems not unlikely that the list may eventually be more than doubled.

General considerations in regard to the anatomical peculiarities of the Nemerteans described below are reserved for a future paper. My reason for postponing this important duty in connection with the study of the collection is that since this article was written, extensive collections of Nemerteans from the west and northwest coasts of America and the Pacific Ocean have been placed in my hands. These collections will doubtless include other forms than those collected on the Harriman Expedition, and it seems desirable that as many as possible be studied before drawing any general conclusions in regard to the anatomical peculiarities presented by the Alaska forms.

KEYS TO GROUPS AND SPECIES.

For convenience in determination, the species at present known from the northwest coast of America may be arranged in the following analytical table, based mainly on superficial and easily distinguishable characters.

A. Proboscis without stylets. Mouth posterior to brain. Intestinal cæcum absent.

a. Lateral nerves external to musculature of body walls.

PROTONEMERTEA.

aa. Lateral nerves imbedded in or between muscular layers of body wallsb.

b. Musculature of body walls in two main layers, to which an inner circular layer is sometimes added in the esophageal region. Cerebral sense-organs absent.....MESONEMERTEA.

bb. Musculature of body walls in three main layers, of which the inner is longitudinal. Cerebral sense-organs present.

HETERONEMERTEA.

AA. Proboscis with stylets. Mouth in front of brain, usually opening with proboscis in a single terminal or subterminal pore. Intestinal cæcum present. Lateral nerves internal to muscular layers of body walls.....METANEMERTEA.

ORDER PROTONEMERTEA.

Body remarkably long, soft, and fragile. Head distinctly marked off from body, usually broader than neck, often flattened dorso-ventrally..... *Carinella*, p. 11.

1. Body very soft, attaining a length of upwards of 2 meters, deep red or bright vermilion..... *C. speciosa*, p. 11

2. Color brown or chocolate with numerous narrow, transverse white rings and five parallel, longitudinal white lines, of which one is in the dorso-median line, and two on each lateral surface.....*C. dinema*, p. 15.
3. Color brown with numerous narrow transverse rings and three parallel, longitudinal white lines of which one is in the dorso-median line and one just below each lateral margin.....*C. capistrata*, p. 16.

ORDER MESONEMERTEA.

A. Body musculature consists of a thin outer circular layer and a strong inner longitudinal layer—an inner circular layer is usually wanting entirely, or, if present, is much reduced. Body long and filiform, often coiled in a close spiral. Head sharply pointed. Mouth placed very far behind the brain. Nephridia not discovered*Cephalothrix*, p. 19.

1. Slender, filiform, pale yellow, sometimes with reddish, grayish or greenish tinge. No ocelli in adult.....*C. linearis*, p. 19.

AA. Body musculature consists of a thin outer circular layer, a diagonal layer, a longitudinal layer, and, in the esophageal region, an additional, enormously developed inner circular layer. Head broader than neck. Nephridia well developed.

Carinoma, p. 20.

1. Body rather stout, flattened posteriorly. Mouth close behind brain. Milk-white with grayish or brownish mottlings, and darker intestinal lobes.

C. griffini, p. 20.

ORDER METANEMERTEA.

A. Body long and slender. Proboscis sheath usually less than half the length of body. Proboscis small; central stylet usually small*Emplectonema*, p. 23.

1. Stylets slender, curved. Dark green or pale green above, and whitish or very pale greenish below.....*E. gracile*, p. 23.
2. Stylets straight and short, with swollen bases. Basis of central stylet swollen and rounded posteriorly. Dark brown above, flesh-color beneath.....*E. bürgeri*, p. 25.

AA. Body moderately elongated. Proboscis sheath about $\frac{1}{2}$ to $\frac{3}{4}$ the length of body. Central stylet well developed.

Paranemertes, p. 32.

1. Two or 4 pouches of accessory stylets. Color purplish brown, dark-brown, or orange-brown above, on sides, and on lateral margins of ventral surface; rest of ventral surface (often only the median third) white or yellowish white.....*P. peregrina*, p. 33.
2. Four pouches of accessory stylets. Opaque white.....*P. pallida*, p. 36.

3. Six to 12 pouches of accessory stylets. Whitish, pinkish or flesh-color..... *P. carnea*, p. 37.

AAA. Body commonly rather short and thick. Proboscis sheath usually reaches nearly or quite to posterior end of body. Proboscis large; central stylet well developed.....a

- a. Ocelli numerous, extending along the lateral nerves beyond the brain. Basis of central stylet massive, with truncate or concave posterior end..... *Zygonemertes*, p. 28.

1. Each of the 2 pouches of accessory stylets contains about 5 stubby stylets. Olive green above and below..... *Z. thalassina*, p. 29.
2. Each pouch of accessory stylets contains 2 or 3 moderately slender stylets. White..... *Z. albida*, p. 31.

aa. Ocelli do not extend posteriorly beyond the brain. Basis of central stylet usually rounded posteriorlyb.

- b. Body not very small. Ocelli usually numerous.

Amphiporus, p. 40.

1. Short and broad. Usually two pouches of accessory stylets with 5 to 7 rather slender stylets each. Dark purplish or chocolate-brown above, with a triangular white spot on each side of the head; ventral surface pinkish or flesh-color..... *A. angulatus*, p. 41.
2. Basis of central stylet but half as long as the slender stylet itself. Usually 4 pouches of accessory stylets. Dorsal surface deep brownish orange with 2 conspicuous oval or dark brown spots on head; ventral surface pale orange or flesh-color..... *A. bimaculatus*, p. 44.
3. Body rounded. Color of females yellowish orange, obscured in intestinal region (in breeding season) by dark-green ova. Males yellowish, with white flecks..... *A. tigrinus*, p. 46.
4. Body rather broad and flat. Whitish, thickly mottled with dark brown blotches and dots; ventral surface whitish..... *A. nebulosus*, p. 48.
5. Body slender, rather small. Ocelli usually 15-40. Usually 3 pouches of accessory stylets, with 2 or 3 stylets each. White.

A. leuciodus, p. 51.

6. Body extremely elongated for the genus. Ocelli usually 60-250, or more. Usually 6 to 12 (most commonly 8) pouches of accessory stylets, with 1 or 2 stylets each..... *A. exilis*, p. 54.

bb. Body very small. Ocelli few; usually 4 well-developed ocelli arranged in a rectangle; but sometimes these 4 eyes are double or are fragmented into 4 groups of ocelli; occasionally ocelli are wanting..... *Tetrastemma*, p. 57.

1. Ocelli 4. Brownish-red above, with median, white stripe; ventral surface white..... *T. bicolor*, p. 57.
2. Ocelli of 4 groups, each consisting of several pigment spots of irregular size. Pale yellow..... *T. aberrans*, p. 58.
3. Ocelli wanting. Hermaphroditic. Whitish..... *T. caecum*, p. 59.

ORDER HETERONEMERTEA.

- A. Head without deep lateral, longitudinal furrows. Proboscis musculature of two layers.....*Tæniosoma*, p. 61.
1. Of very large size, reaching a length of 2 meters and a diameter of 18 mm. Deep yellow, thickly sprinkled with small irregular, dark red spots.
T. princeps, p. 62.
- AA. Head with deep, horizontal furrows. Proboscis usually with three muscular layers and muscular crossings.
- a. Caudal cirrus absent. Body long and slender, rounded or flattened; very contractile.....*Lineus*, p. 64.
 1. A single row of 4-6 (or sometimes 8) ocelli on each side of head. Dusky, or brownish green, dark brown, or reddish brown; commonly paler beneath*L. viridis*, p. 65.
 2. No ocelli in adult. Dark, reddish brown or purple, with a narrow transverse white band connecting posterior ends of cephalic furrows across dorsal surface of neck.....*L. torquatus*, p. 66.
 - aa. Caudal cirrus present. Body rather firm; incapable of swimming.....*Micrura*, p. 68.
 1. Dorsal surface deep purple or wine-color with 15-40 sharp, pure white, transverse lines; tip of snout with triangular, bright orange spot; ventral surface of body pure white.....*M. verrilli*, p. 68.
 2. Body flattened, grayish brown above with narrow, colorless, transverse lines; with a small, flesh-colored, sub-truncate head, much narrower than body, and with minute gray spots near antero-lateral margins.
M. impressa,¹ p. 70.
 3. Salmon or flesh-color (more rarely light brownish); lighter, with tinges of brighter red, or nearly colorless anteriorly. Intestinal lobes more deeply colored, sometimes chestnut-brown. A cream-colored stripe is conspicuous in the ventral median line.....*M. alaskensis*, p. 71.
 - aaa. Caudal cirrus present in perfect specimens, but often missing. Body long and flat, with thin lateral margins. Swims readily. Dorso-ventral and diagonal muscles well developed. Eyes usually absent.....*Cerebratulus*, p. 74.
 1. Very large and stout, becoming 2 meters or more in length, and 25 mm. in width. Dark, reddish brown.....*C. herculeus*, p. 75.
 2. Large and ribbon-like. Slaty brown to grayish green, with thin, white, lateral margins.....*C. marginatus*, p. 75.
 3. Rather short. Chestnut-brown or reddish brown in esophageal region, chocolate-brown in intestinal region above; brownish flesh-color to dark brown beneath, with a median longitudinal ochre stripe along ventral surface.....*C. occidentalis*, p. 76.

¹Known only from Stimpson's original description—Proc. Acad. Nat. Sci., Philadelphia, p. 160, 1857.

4. Head and anterior portions of body narrow and slender, with remarkably long and deep cephalic furrows. Dark brown or purplish, paler on borders of cephalic slits and tip of snout.....*C. longiceps*, p. 77.
5. Very long and ribbon-like, becoming 2 meters or more in length. Deep blood-red except tip of snout, which is yellowish white both above and below*C. montgomeryi*, p. 80.
6. Reddish purple except head which is white on both dorsal and ventral surfaces back to anterior border of mouth.....*C. albifrons*, p. 82.

SYSTEMATIC DISCUSSION OF GENERA AND SPECIES.

Carinella Johnston.

Mag. Nat. Hist. London, vi, p. 232, 1833.

The species belonging to this genus are characterized by a slender, soft, rounded body, capable of extending and contracting to a remarkable degree. Head distinctly marked off from body, usually much broader than parts immediately following, often flattened dorso-ventrally, and disk-like.

On each side of body a transverse furrow separates the head from the esophageal region. Proboscis opening subterminal; mouth a small round opening on ventral surface just back of lateral transverse furrows. The lateral nerves lie outside the muscular layers of the body, and just beneath the basement layer of the integument. The body walls are made up of a very thick outer epithelium with abundant glands, a basement layer, a circular muscular layer, and a longitudinal muscular layer in the order named from without inwards. In addition to these there is, in the esophageal region, an inner circular muscular layer which often forms a dorsal, and sometimes a ventral crossing with the fibers of the outer circular muscular layer.

Proboscis sheath usually not more than $\frac{1}{3}$ the length of body. Proboscis small and short. Ocelli wanting. Cerebral sense organs usually represented simply by a pair of sensory pits in the epithelium, although some species (cf. *C. speciosa*) possess a pair of well-developed sense organs with ciliated canal, ganglion cells and glands. A pair of peculiar lateral sense organs is usually situated well back in the esophageal region. Some of the species show elaborate markings of fine white lines on a brownish body, others are homogeneous in color. Most species are colored in some shade of brown or red; some are bright vermilion.

1. *CARINELLA SPECIOSA* sp. nov.

Pl. III, fig. 6; Pl. IX, figs. 1-3; Pl. X, figs. 1, 2.

Body large, very long, flattened below, rounded above, and remarkably soft and pliable. This beautiful Nemertean closely resembles *C.*

polymorpha in external appearance, but is more brightly colored, and shows conspicuous peculiarities in its internal anatomy. The body is even softer than that of *C. polymorpha*, and more distensible; and the species is easily distinguished by the presence of enormously developed cephalic glands, by having very highly specialized and sharply defined cerebral sense organs (with ciliated canal, lined with glandular and sensory cells), by the peculiarities in the nephridia, and by many other details of structure.

Head rounded in front, broader than parts immediately following, from which it is marked off by lateral, transverse furrows. Proboscis opening and mouth as in other species of the genus. Body variable in thickness in its different portions according to state of contraction of the particular part, but usually flattened below and rounded above, with well-rounded lateral faces; posterior portion of body much more slender than anterior.

The worms are very sluggish. When coiled together the turns of the body are irregular and angular.

Color.—This is the most brilliantly colored and unquestionably the most striking Nemertean encountered on the expedition. The color of the whole body was a deep, rich vermilion, becoming somewhat paler and more yellowish towards the posterior end. In formalin or alcohol the natural color quickly disappears, although a characteristic marking still remains. This feature is peculiar to *C. polymorpha* as well. About 25 to 40 mm. back from the tip of the head (in a large specimen) is a broad band of dark brown color reaching entirely around the body. This band is commonly 10 to 30 mm. in width, is very sharply marked off anteriorly, but fades out gradually behind. All the rest of the body, both in front and behind, is yellowish or grayish. This marking remains after imbedding in paraffin, and even after sectioning and staining in hæmatoxylin there is a sharp line of distinction at the anterior end of the dark band. A single section, cut obliquely, shows the line of demarkation perfectly. The difference lies wholly in the integument and does not affect any of the layers beneath. In the integument the dark band is characterized not only by the presence of an abundance of minute pigment granules, but by a decided change in the staining qualities of the closely packed gland cells.

Size.—The body is very long, one specimen measuring—when suspended by its middle portion, and therefore well extended—fully three meters in length, and about 5 mm. in width. Most specimens, however, were not more than $\frac{1}{4}$ as long.

The epithelium of the body is very thick, and filled with closely packed gland cells. The two circular muscular layers in the esophageal region show almost no indication of a mutual crossing of fibers either above or below, although, as indicated in Pl. IX, fig. 3, a few fibers of connective tissue and fine nerve fibers pass at intervals from the region of the median dorsal nerve to the internal circular muscles.

Proboscis.—Attached to tissues of head just opposite the mouth, and therefore a considerable distance back of the brain commissures. Its posterior attachment is in the region of the efferent nephridial ducts. The muscular layers are as in other species of the genus. Two large nerves enter the latero-ventral portion of the proboscis at its attachment, and pass backwards on opposite sides just internal to the circular muscular layer.

The *proboscis sheath* shows a homogeneous basement layer beneath its internal lining of flattened epithelium. The musculature consists wholly of circular fibers, except that there is a distinct layer of longitudinal muscles between the circular muscles of the proboscis sheath and the epithelium of the esophagus. Lying on the muscles of the proboscis sheath is a small median dorsal nerve which runs parallel with the median nerve outside the circular body-muscles and corresponds to the inner median nerve of other species.

The esophagus is provided with a pair of nerves continuous with the unusually large buccal nerves. The cerebral ganglia are situated wide apart, as in other species. The anterior portion of the head receives a considerable number of remarkably large nerves (Pl. IX, fig. 1).

Cerebral sense organs.—These organs deserve special attention because of their high degree of development. They are each provided with a narrow but distinct canal leading outward to the lateral surface of the integument. The sense organs lie immediately external to the dorsal ganglia, from which they are separated only by a few fibers of connective tissue which here represent the integumental basement membrane (Pl. X, fig. 2). In size, position and structure these organs are closely similar to those of *C. annulata*, as figured by Bürger.¹ Each consists of a large, rounded mass of nerve cells and connective tissue surrounding a narrow, central canal lined with ciliated and specialized sensory epithelium (Pl. IX, fig. 2). Peripherally there is an abundance of peculiar glandular cells, and the whole is separated from the surrounding integumental cells by a thin

¹ Fauna und Flora des Golfes von Neapel, Monogr. 22, Pl. XII, fig. 5.

sheath of connective tissue. The central canal leads ventrally and outwards to open through the epithelium of the lateral margin of the head. The sense organs are innervated by several large nerves from the adjacent dorsal ganglion (Pl. x, fig. 2).

Cephalic glands.—Enormously developed, making up a large portion of tissues of snout (Pl. ix, fig. 1). These glands are closely packed throughout the tissues internal to the integument, and form thick layers around the cephalic blood lacunæ and the rhynchodæum. Nearer the brain region they become more scattered, and disappear just in front of the ganglia, those about the rhynchodæum reaching back a little farther than those situated external to the blood lacunæ. The secretion from the glands stains most intensely with hæmatoxylin. Most of the anterior glands pour out their secretion on the tip of the snout; those farther back open along the whole circumference of the body, but most abundantly near the lateral margins (Pl. ix, fig. 1). Still farther back all the glands open laterally.

Nephridia.—Situated mainly in, and a little behind, middle third of esophageal region. There is a single large longitudinal canal on each side, lying in close contact with the dorsal walls of the large, lateral blood lacunæ (Pl. ix, fig. 3). The nephridial canals reach forward about as far as the anterior end of the broad band mentioned above as becoming darkly colored in alcohol. Near its posterior end each canal exhibits a peculiar relation with the outer integument. At several points in each canal the dorsal wall of the canal becomes discontinued and the inner ends of the integumental cells reach inward into the lumen of the canal (Pl. x, fig. 1). Sometimes this infolding of the integumental cells occupies a large part of the lumen of the nephridial canal. Superficially these areas always show one or more openings in the outer layers of the integument, but such openings do not penetrate the nephridial canal. At the posterior end of each nephridial canal there is one, or sometimes two, efferent ducts (Pl. ix, fig. 3) which lead to the dorso-lateral surface of the body, as in other species.

Habitat.—The species was found at Hot Springs (near Sitka), Virgin Bay in Prince William Sound, and at Dutch Harbor, Unalaska.¹ Individuals were occasionally seen crawling about on the bottom beneath the water, and in such instances were extremely conspicuous, because of their large size and brilliant vermilion color. They were more commonly found under stones near low-water mark, but were nowhere abundant.

¹ Collected also by Mr. Shearer at Vancouver Island, B. C.

2. CARINELLA DINEMA sp. nov.

Pl. I, figs. 2, 3.

This species somewhat closely resembles *C. superba* in general color of body and the thread-like markings thereon. It differs from this and allied species in many details, and especially in having *two* lateral longitudinal white lines on each side—hence the specific name.

Body long and slender, largest in esophageal region, rounded anteriorly, somewhat flattened on ventral surface posteriorly. Head broad, flat, often emarginate in front; lateral, transverse furrows back of head deep and conspicuous. Proboscis-pore subterminal. Mouth rather large for the genus, elongated and situated slightly in front of second white ring.

Color.—General color dark brown with a more or less pronounced yellowish tone, becoming more nearly yellow posteriorly. The markings of fine longitudinal and transverse white lines on this ground color are very characteristic and stable. Five parallel, longitudinal lines run nearly the whole of the length of the body, and there are a great number of transverse lines. Of the five longitudinal lines, one lies in the middle of the dorsal surface and extends from the most anterior transverse ring to the posterior end of the body. The other four lie symmetrically on the sides—two almost on the lateral margins; the other two much nearer the ventral surface. Seen in section, the distance between the dorsal median line and the upper of the two lateral lines on each side is 90° . Two lateral lines on either side are separated by about 45° , while the remaining 90° lies between the two lower lateral lines. All the four lateral lines extend from the second transverse line to about $\frac{3}{4}$ the distance towards the posterior end of the body. Here they become interrupted, and back of this they are usually indicated only by short segments and scattered dots, though their course may be traced nearly to the end of the body. The five longitudinal lines are all very fine and sometimes consist of rows of fine white dots closely placed together. In addition to these five longitudinal lines some individuals show an indication of a median ventral longitudinal line in the form of a row of isolated fine white dots extending from behind the mouth nearly to the fifth white ring.

The first transverse white marking lies near the tip of the snout. It is somewhat wavy in outline and does not reach below the lateral margin. The second white marking is broader than the first, but is likewise limited to the dorsal surface. It is indicated, however, on the lateral surface by two narrow and inconspicuous spots. The third

marking is not represented on the lateral surfaces, but is sharp on the dorsal surface, and is indicated on the ventral surface by a few scattered white dots. The fourth marking is very sharp and extends as a ring completely around the body. The fifth is broader than any of the other rings. The sixth is usually merely indicated by a series of fine dots. Posterior to the sixth, there are commonly as many as 150 more or less distinct and perfect rings, arranged at fairly regular intervals throughout the length of the body. They are much more conspicuous on the dorsal than on the ventral surface. In fact a large number of them are interrupted on the ventral surface and represented only by isolated dots. When the rings are well developed each consists of two very fine white rings lying side by side, with a fine brown ring between them. Over the greater portion of the body are alternating wider and narrower white rings, or double and single rings, but there are always exceptions to the regularity of arrangement. The white lines, both longitudinal and transverse, appear as if formed by a coating of fine white particles on the surface of the body.

The region of the proboscis-pore is very pale. Extending outward and backward on each side from a point just above the proboscis-pore is a shallow, horizontal groove. Each of the grooves is marked by a black line, and each extends backward as far as the first transverse white line. They do not quite meet in front however. The borders of the mouth are pale in color. The sides of the brain region are dark reddish.

In alcohol the body is grayish as far back as the fourth white ring. Here it abruptly changes to black, which fades into dark brown throughout the remainder of the body. The markings are well preserved.

The '*side organs*' are indicated as a pair of rounded pits lying just anterior to the fifth white ring and immediately below the dorsal of the two white, lateral, longitudinal lines on each side.

Habitat.—This species was found on the piles of a wharf at Victoria, B. C., and was also found among hydroids, etc. at Sitka. The worms were from 300 to 500 mm. long in extension, with a diameter of about 2 to 3 mm. They inhabited grayish, fragile, parchment-like tubes, which were commonly much twisted and coiled. But few specimens were met with.

3. CARINELLA CAPISTRATA sp. nov.

Pl. 1, fig. 1.

This, like the preceding species, resembles *C. superba* (Kölliker) Bürger somewhat closely in color and general appearance. A careful

examination of a number of individuals, however, shows that the markings on the body present such constant differences that the two species must be considered distinct. *C. capistrata* is likewise different from any of the other related and described species. It may at once be distinguished from *C. superba* by lacking all indications of a median ventral white line. The markings on the head and the arrangement of the anterior transverse white lines distinguish it easily from *C. annulata* and *C. nothus* Bürger; from *C. dinema* it may be separated by the presence of but one pair of lateral white lines, instead of the two pairs found in *C. dinema*.

C. capistrata is a very large species, attaining a length of more than a meter with a diameter of about 5 mm. near the anterior end, and of 2 to 3 mm. farther back. The worms are therefore extremely long and slender, and the diameter in the esophageal region is twice as great as it is farther back. The body is strongly rounded on the dorsal surface throughout its whole length; the posterior end is very slender and easily broken.

Head broad, flattened dorso-ventrally, rounded or emarginate in front, sharply marked off from succeeding portions by a pair of deep, lateral, transverse constrictions, or furrows. Proboscis-pore minute, subterminal, bounded on each side by a shallow horizontal groove. Mouth small, slightly elongated, situated immediately behind the lateral furrows.

Color.—General color of body rich, deep brown, sometimes varying towards grayish black; posteriorly becoming lighter, and of a yellowish brown. On this ground color is a series of conspicuous, but fine, longitudinal and transverse white lines (Pl. I, fig. 1). The longitudinal lines are three in number and parallel—one in the middle of the dorsal surface, the others just ventral to the lateral margins. The dorsal line extends without interruption from near the tip of the head to the posterior end of the body. The lateral lines, on the other hand, are much broken up in the anterior portions of the body, and in the esophageal region are only indicated at intervals, though their course can be followed nearly to the head; throughout all the rest of the length of the body they are sharp and distinct.

The transverse white lines, excepting the most anterior one, completely encircle the body. This first transverse line appears as a sharp V-shaped marking a little back of the head. Its angle is directed backward and its extremities reach but little below the lateral margins. The median dorsal line passes through the angle of this V-shaped marking, and at the point of intersection the white area is somewhat

enlarged to form a small oval spot. The second transverse marking is situated some 20 to 30 mm. (in large individuals) from the first, and completely encircles the body. This ring is always sharp and conspicuous, and in alcoholic specimens is still more distinct in that it separates a paler anterior portion from the much darker succeeding parts. The third transverse ring is also complete, and is commonly separated from the second by about half the distance that this is separated from the first. The fourth and fifth rings are sometimes interrupted below, but are more usually complete, and are much nearer together than the second and third. Back of the fourth or fifth ring we find a regular succession of complete rings to the end of the body. It is common to find as many as 200 such rings arranged at fairly regular intervals and separated from each other, when the worm is contracted, by an average distance of about the diameter of the body. Some of the rings are wider than others, but nearly all are as narrow as fine threads; a few are more or less interrupted.

The anterior and lateral margins of the head are bordered by a narrow band of light color, as in several other species, but this is mainly visible from the ventral surface.

The '*side organs*' are indicated by a pair of small pits situated in the third transverse white ring and just dorsal to the position of the lateral lines. Their position is about the same, therefore, as in *C. superba*.

In alcoholic specimens the arrangement of the white longitudinal and circular lines is still distinguishable, except near the anterior end of the body, which, back to the second transverse marking (first complete ring), is pale or grayish brown. Back of this the color abruptly changes to very dark brown or black, which reaches posteriorly 50 to 75 mm. (in large individuals) and then gradually fades out into light brown, which continues to the end of the body. The color is usually paler on the ventral than on the dorsal surface.

Habitat.—This species was found in abundance under stones near low-water mark at Orca and Virgin Bay in Prince William Sound, but was not met with elsewhere. The worms lived in long, fragile, grayish, paper-like tubes of about the same diameter as the body. These tubes were usually twisted about horizontally beneath the stones under which the animals live. They were also frequently occupied by a species of polychæte annelid (*Nereis*), which was often associated with the Nemertean. The worms are sluggish in their movements, and break up posteriorly if roughly handled.

Cephalothrix Oersted.

Entwurf der Plattwürmer, Kopenhagen, 1844.

This genus includes very long, slender, filiform species which show a tendency to coil in a close spiral. Brain situated well behind tip of snout; mouth several times as far posteriorly. Head sharply pointed in extension; proboscis-pore on ventral side a little back of its extremity. Inner circular muscular layer very much reduced, or (commonly) entirely absent, the body musculature consisting of a thin outer circular muscular layer and a strong inner longitudinal layer; lateral nerves situated in the longitudinal muscular layer; cerebral sense organs and cephalic furrows wanting. These worms resemble in external appearance some of the slender Nematodes.

4. **CEPHALOTHRIX LINEARIS** (Rathke) Oersted.

Planaria linearis RATHKE, Skrivter af Naturhist. Selsk. Kjöbenhavn, v, p. 84, 1799.

Cephalothrix linearis OERSTED, Entwurf der Plattwürmer, p. 82, Kopenhagen, 1844.

A very slender thread-like species capable of great extension and contraction. Individuals may be extended till they resemble a very fine thread, but when disturbed commonly coil themselves into a closely wound spiral. Body commonly rather thicker in the middle and tapering toward both extremities. Head very long, acutely pointed when extended. Proboscis-pore situated ventrally, some little distance back from tip of snout. Mouth very far back; commonly distant from tip of snout 10 to 12 times the diameter of body; or it is perhaps 4 to 5 times as far back as is the brain.

The length is subject to the greatest variation. Alaska specimens commonly extended themselves 3 to 6 inches or more, but could contract to a small fraction of this length.

Ocelli.—Wanting in adults although the embryos are provided with a single pair soon after leaving the egg.

Color.—Usually pale yellow throughout, but some specimens had a distinct reddish tinge, and some were gray, greenish, or pale green. A median paler line, due to the proboscis sheath, appears on the dorsal surface in the esophageal region.

Habitat.—The species is very common well up toward high-water mark under stones in muddy places, among decaying mussels, etc. The worms were commonly found where the mud was black, slimy, and very foul. Scores of specimens were sometimes found under a single stone. They were often associated with slender red-

dish Nematodes. Very abundant at New Metlakahtla, Glacier Bay, Sitka, Orca and at other places. The species is also common on the coast of New England, and is likewise found along the shores of northern Europe and in the Mediterranean.

Carinoma Oudemans.

Circulatory and Nephridial Apparatus of the Nemertea, Quart. Journ. Micr. Sci., xxv, Suppl., pp. 1-80, 1885.

Body usually slender, often thickened and rounded anteriorly, flattened in intestinal region; head usually wider than parts immediately following; mouth situated immediately behind the brain; proboscis pore subterminal. Lateral slits, cephalic groves, and cerebral sense organs wanting. Intestine with paired, lateral diverticula.

Body musculature composed of two muscular layers throughout length of body, and of localized supplementary layers. These consist of a thick internal longitudinal layer and a thin external circular layer, but in the esophageal region a second circular layer lies internal to the longitudinal muscles, and just in front of the nephridial region becomes enormously thickened. In the anterior portions of the esophageal region a double set of distinct diagonal muscles lies just internal to the outer circular muscular layer.

The lateral nerves are situated within the longitudinal muscular layer.

In the anterior portions of the esophageal region are three pairs of longitudinal blood vessels, of which one pair represents the main lateral vessels and lies beside the esophagus, a second pair lies beside the proboscis sheath, and the third pair is situated internal to the ventral wall of the proboscis sheath and projects freely into the rhynchocœl.

5. CARINOMA GRIFFINI sp. nov.

Two¹ species of this interesting genus are already known from other parts of the world — *C. armandi* Oudemans, which is found

¹ Miss C. B. Thompson has very recently added a third species, *C. tremaphoros* (Zool. Anz., Vol. xxiii, No. 631, pp. 627-630, Dec., 1900, from a single specimen collected at Woods Hole, Mass. I have found this species rather abundantly in a large pond at Falmouth, Mass., connected with Vineyard Sound by a very narrow outlet, and consequently but little affected by the tides. The species must be unusually hardy, for the worms lived just on the edge of the pond in sand much blackened by decaying organic matter. They have moreover to endure great changes in the salinity of the water due to irregularity in rainfall and evaporation. Further notes in regard to the anatomy of this species will be published later, together with colored figures of the living worms.

occasionally on the shores of England, and *C. patagonica* Bürger, of which a single specimen has been collected from the Straits of Magellan.

This new species was found by Mr. Creswell Shearer at Albert Head on Vancouver Island. It attains a length of upwards of 600 mm. and a diameter of 3-5 mm. Anterior portions of body cylindrical; intestinal region much flattened. Head broader than neck, and pointed, rounded or emarginate in front according to the state of contraction (figs. 1 and 2).

No ocelli were found.



FIG. 1.

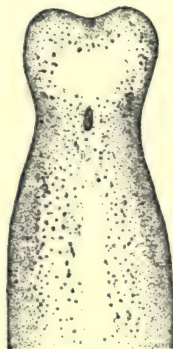


FIG. 2.

FIGS. 1 and 2. *Carinoma griffini* sp. nov. Anterior part of ventral surface. 1. Head extended and pointed. 2. Head contracted and emarginate. $\times 8$.

Color.—General color milk-white anteriorly, with brownish mottlings farther back; intestinal lobes darker. After preservation the color is completely lost, and the body becomes nearly cylindrical throughout.

Body walls.—In internal organization this species agrees closely with the descriptions which Bürger gives of *C. armandi*¹ and of *C. patagonica*,² but presents a number of peculiarities, which may be stated briefly as follows: Outer integument divided into a superficial and a deeper layer of epithelial cells, separated by a network of connective tissue fibers. Basement layer in esophageal region about equal in thickness to the integument itself, but is much thinner farther back. Beneath basement layer in esophageal region is a loose sheet of circular muscles, and beneath this a double set of diagonal muscular fibers.

¹Fauna u. Flora des Golfes von Neapel, Monogr. 22, Nemertinen, 1895.

²Zeits. f. wiss. Zool., Vol. LXI, pp. 19-20, pl. 3, figs. 1-9, 1896.

The main longitudinal muscular layer in most regions of the body equals in thickness that of all the other muscular layers combined. The lateral nerve cords lie imbedded in this layer. Internal to the longitudinal muscles lies a small amount of gelatinous tissue or parenchyma of the body cavity. The inner circular muscular layer extends from the mouth to the posterior end of the esophageal region. Its fibers are continuous with those of the proboscis sheath. Anteriorly, it is even thinner than the outer circular muscular layer, but towards the posterior end of the esophageal region it increases so greatly in massiveness that for a short distance it exceeds in thickness the other muscular layers combined. Having reached its maximum development (near the efferent nephridial ducts), it suddenly disappears entirely, its dorsal portion remaining for a few sections as a semicircular arch above the proboscis sheath.

Proboscis sheath.—This organ is more strongly developed than in the other species of the genus, and possesses a single muscular layer composed of circular fibers interlaced with longitudinal fibers in small groups.

Proboscis.—The anterior end of the proboscis is attached to the tissues of the head at about the middle of the brain region. Its walls consist of a thin outer fibrous layer, on which rest the superficial flattened epithelial cells bathed in the fluid of the rhynchocœl. Beneath is the thick layer of longitudinal muscles comprising nearly the whole of the musculature. Internal to these are a few scattered circular fibers, then a thin basement membrane, and, finally, the internal layer of columnar epithelial cells. This inner epithelium is composed of a simple layer of very long and closely pressed cells, a portion of which contain rod-like masses of secretion. Their nuclei are closely packed together peripherally, and comprise several layers as is usual in much crowded columnar cells.

A pair of rather large nerves extend throughout the length of the proboscis just internal to the circular muscular layer. These nerves originate from the ventral commissure of the brain very much as in *Carinella*. They arise from the anterior border of the commissure near its origin from the ganglia, and pass dorsally to the point where the proboscis is attached to the tissues of the head. They then enter the proboscis, and take up lateral positions in its walls corresponding to those of the lateral nerves in the walls of the body.

Nephridia.—The condition of the nephridial system is in many respects intermediate between that of *C. patagonica* and *C. armandi*, the mass of tubules constituting the so-called nephridial glands not ex-

tending into the cavity of the blood space nearly so far as in the former, but are much more profusely branched than in the latter species. The single pair of efferent ducts lies in the same region as the posterior ends of the series of 'nephridial glands.' Posteriorly to this point a single unbranched duct of large size runs backward on each side for a considerable distance, and then bends sharply and runs forward to the efferent duct, always lying close beside, and just external to that limb of the duct which is passing backward. The efferent ducts open on the dorso-lateral surfaces of the body at the posterior end of the enormously thickened internal circular muscular layer.

The blood vascular system, brain, buccal nerves, lateral nerves, and dorsal and ventral median nerves are much as in *C. patagonica*.

Specimens collected in August had just discharged their sexual products. In one individual a very few genital sacks still retained their mature ova.

Emplectonema Stimpson.

Emplectonema STIMPSON, Proc. Philadelphia Acad., p. 163, 1857.

Nemertes MCINTOSH, British Annelids, Part I, Nemerteans, Ray Society, 1872-1873.

Eunemertes VAILLANT, Hist. Nat. des Annelés, Tome 3, Paris, 1890.

Body very long and slender, varying greatly in thickness according to state of contraction, but most commonly considerably flattened; often sharply bent and folded into an irregular mass; integument provided with an unusual abundance of mucous secretion; proboscis and mouth opening together on subterminal portion of snout; proboscis sheath limited to anterior third of body; proboscis slender and very short, often not more than $\frac{1}{6}$ the length of body; a large number of minute eyes usually present; cerebral sense organs situated well in front of brain, and usually very small. The species are of sluggish movement, and many of them are found very near high water mark among mussels, barnacles, rockweeds, etc.

Of the genus *Emplectonema* two species, of which only one (*E. gracile*) had previously been described, were found on the Harriman expedition.

6. EMPECTONEMA GRACILE (Johnston) Verrill.

Pl. VIII, fig. 3.

Nemertes gracilis JOHNSTON, Mag. Zool. and Bot. London, vol. 1, 1837-38.

Emplectonema viride STIMPSON, Proc. Philadelphia Acad., p. 163, 1857.

Eunemertes gracilis VAILLANT, Hist. Nat. des Annelés, Tome 3, Paris, 1890.

Eunemertes gracilis BÜRGER, Fauna u. Flora des Golfes von Neapel, Monogr. 22, Nemertinen, p. 543, 1895.

Emplectonema gracilis VERRILL, Trans. Connecticut Acad., VIII, p. 413, 1892; ix, p. 146, 1895.

Body very long and slender, somewhat flattened below, irregular and ungraceful in form, and sluggish in movement. Head slightly broader than rest of body; snout blunt, posterior extremity of body tapering gradually to a point.

The common opening of the mouth and proboscis lies ventrally, a little back from the tip of the snout. The cerebral sense organs lie far in front of the brain, and each communicates with the exterior by a canal which opens on the ventro-lateral margin near the tip of the snout.

Color.—Uniform dark green above and nearly white below; sometimes grayish or yellowish green above, and very pale yellowish green below. The color of Alaska specimens is as a rule paler and more grayish green than in Mediterranean specimens. The head is bordered with a narrow band of white, uniform with that of the lower surface. Back of the head is an inconspicuous transverse band paler than the rest of the dorsal surface. The pigment resides wholly in the integument, the muscular layers and other organs of the body being practically colorless.

Ocelli.—The eyes (fig. 3) are characteristically arranged in two groups on each side of the head. The anterior group on each side usually consists of 8 to 10 pigment-cups arranged in a single row near the antero-lateral border of the head. These lie deeply imbedded in the tissues of the head, and are much more conspicuous from the ventral surface owing to the presence of much pigment on the dorsal surface above them in ordinary states of contraction. Each posterior group lies nearly above the brain and consists of 10 to 20 ocelli in an irregular cluster. The eyes of the posterior groups are visible only from the dorsal surface, and are smaller in size than those of the anterior groups. The integument may be scraped off so as to expose the eyes clearly.



FIG. 3. *Emplectonema gracile*. Dorsal view of head to show arrangement of ocelli. $\times 12$.

Proboscis.—The stylet apparatus is especially characteristic of the species. The basis of the central stylet is very long and slender, and is twice to three times as long as the stylet itself. The posterior end is sharply swollen into a flattened knob (pl. VIII, fig. 3). In front of the knob the basis decreases in diameter evenly towards the anterior end, except for a slight constriction which occurs at about $\frac{1}{3}$ the distance from the posterior end. The anterior portion is slightly

curved. The central stylet is slender, extremely sharply pointed, and gracefully curved like a sabre or scythe. There are two accessory stylet pouches, and each commonly contains 5 to 7 slender stylets curved like the central one, and of approximately the same size (Pl. VIII, fig. 3).

Habitat.—This species was found in the greatest abundance at nearly all the collecting stations between Victoria, B. C., and Dutch Harbor, Unalaska. It occurred everywhere along the shore, and was most plentiful near high water mark, crawling over the thick growth of mussels and seaweeds. Often a number of individuals were found coiled together in a single slimy mass, and on being disturbed would crawl apart and move sluggishly about, but usually made no effort at concealment. Similar masses were met with under stones in very muddy localities, and often where the water was very brackish. This is probably the most abundant species of Nemertean on the Alaska coast, and is found nearer high water mark and in more brackish water than almost any other species.

The species has previously been recorded from the coasts of England, the northern shores of Germany and France, the Mediterranean, and Madeira. It was also found by Stimpson under stones between tides in San Francisco harbor and described as *E. viride*.

An excellent and detailed account of the minute anatomy of this species is given in Bürger's Monograph of the Nemerteans of the Gulf of Naples.¹

Specimens collected in Alaska in June and July were filled with nearly mature genital products, in closely packed, but irregularly arranged pouches. The genital glands were often noticeable from the exterior because of their pale color.

7. EMPLECTONEMA BÜRGERI sp. nov.

Pl. II, figs. 1, 2; Pl. VIII, fig. 1; Pl. XII, fig. 3.

Body long, flattened both above and below, ribbon-like, as thick near the edges as in the median line; head usually narrower than the parts immediately following; posterior extremity slender. The rhynchodæum opens on the ventral side of the tip of the snout; a pair of shallow lateral slits occur just in front of the mouth.

The worms attain a length of more than a meter, and are 5 mm. or more in width. Like other species of the genus the integument is furnished with a vast amount of mucus.

¹ Fauna u. Flora des Golfes von Neapel. Monogr. 22, 1895.

Color.—The color varies considerably, as will be seen from the two color varieties on Pl. II, figs. 1 and 2. The commonest form is dark velvety-brown above, with a paler median line, much paler and slightly yellowish in front, and flesh-colored or creamy white below. Other individuals have the whole dorsal and lateral surfaces of a mottled reddish brown color, with a tinge of purple, while the ventral surface is pale yellow or flesh-colored. Sometimes the head is nearly colorless. The dorsal surface almost always has an appearance suggestive of velvet. This color is superficial, and is easily removed by rough handling.

Proboscis.—Proboscis small, very short and delicate, sometimes scarcely more than $\frac{1}{10}$ the length of body. The proboscis sheath reaches well toward middle of body, but is very small toward its posterior end; in esophageal region it is well developed, with a thick outer layer of circular muscles, and a thin, inner, longitudinal muscular layer. The rhynchodæum passes backward a considerable distance before the intestinal canal is separated from the proboscis opening.

The armature of the proboscis consists of a weak central stylet, and a pair of pouches of accessory stylets (Pl. VIII, fig. 1). The basis of the central stylet is rather slender in front, slightly contracted near its posterior third, from which point it swells out suddenly into a large spherical bulb. The central stylet is slightly shorter than its basis. Each of the reserve pouches usually contains three small stylets with swollen bases. The posterior chamber of the proboscis is narrow. The proboscis is provided with 11 distinct nerves.

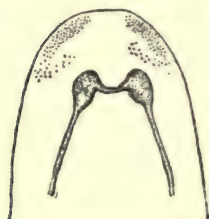


FIG. 4. *Emplectonema bürgeri*. Dorsal view of head to show arrangement of ocelli. $\times 8$.

Ocelli.—The ocelli are very numerous. On each side of the tip of the snout is an elongated cluster of minute eyes, all situated near the dorsal surface, and without regularity of arrangement. Their number is commonly 60 or more on each side (fig. 4). Back of these are a few other eyes, likewise very minute, situated deep in the tissues of the body, and seen only with difficulty. They are scattered irregularly from near the lateral borders in front of the brain inward towards the median line (fig. 4).

Cerebral sense organs.—Unusually large. They lie lateral to the rhynchodæum, and slightly in front of the brain. The ducts by which they communicate with the exterior pass forward to open latero-ventrally.

The pair of *blood lacunæ* in the head are rather small, and pass backward in numerous branches. The dorsal vessel in the proboscis sheath has several communications with the lateral vessels in the esophageal region.

In the region of the brain a great abundance of *sub-muscular glands* appears, occupying the whole lateral aspects of the body and reaching far backward. As usual, they are multicellular. Their ducts pierce the muscles and integument of the body wall to open on the sides of the body in enormous numbers. Farther back they are restricted to a narrow region in each section just lateral to the nerve cords, and open somewhat ventrally from the lateral edge. They continue in diminished numbers, but of large size, backward beyond the point where the esophagus opens into the intestine (Pl. XII, fig. 3).

Alimentary canal.—A pair of remarkably narrow intestinal cæca reach forward well toward the brain. Their diameter for a long distance back is insignificant compared with that of the esophagus. They occupy positions ventro-laterally to the proboscis sheath and above the esophagus. Occasional pouches are sent off laterally into the tissues above the nerve cords. Farther back they become larger and extend laterally beyond the ventrally placed nerve cords. Towards the middle of the esophageal region the pouches become paired with considerable regularity. A well developed network of muscular fibers and connective tissue reaches between the pouches from the muscular layer above to that below the alimentary canal. The pouches lie close together still farther back, and near the posterior end of the esophageal region extend on each side below the esophagus and open together from opposite sides. The two intestinal cæca are thus connected together. From this point backward the esophagus decreases rapidly in size, the cæcum becomes large and is divided into numerous pouches by fibrous partitions extending between the muscular layers above and below, and eventually the esophagus opens into the intestine by a narrow slit in its dorsal wall (Pl. XII, fig. 3).

Reproductive organs.—Far in front of the opening of the esophagus into the intestine the reproductive glands make their first appearance. The anterior pouches are scattered, and lie above the intestinal cæca well towards the sides of the body. These open directly on the dorso-lateral surfaces. Farther back similar ones appear below the intestinal canal, and these open ventrally (Pl. XII, fig. 3). In the intestinal region the glands are very numerous and are scattered just inside the muscular layers all over the body—dorsally, ventrally and laterally. As many as 20 to 30 glands in a male are met with in a single section.

Their ducts lead directly to the surface of the body, and consequently open at any point instead of in certain definite regions as in many species.

Both lateral nerves and blood vessels join above the hind gut as in most other Nemerteans—the union of the nerves lying ventral to that of the blood vessels.

This species is named in honor of Prof. Dr. Otto Bürger, of Göttingen, whose monograph on the Nemerteans of the Gulf of Naples forms by far the most important contribution which has yet appeared relating to this group of worms.

Habitat.—Several individuals are often found knotted together in a seemingly inextricable mass. The body lies coiled in a mass, and is bent and folded in sharp angles.

The species was found under mussels on rocks between tides at Glacier Bay (W. E. Ritter) and at Sitka.

Zygonemertes Montgomery.

Zool. Jahrb., x, p. 2, 1897.

A species of Nemertean was found at Sitka which agrees very closely with Verrill's description of *Amphiporus virescens*.¹ The detailed anatomical description given by Montgomery,² however, shows at once that the Alaska Nemertean is a distinct species. Montgomery has created a new genus for *A. virescens* Verrill based on its anatomical peculiarities, especially the structure of the proboscis and proboscis sheath. This genus he named *Zygonemertes*, with the following characters as its chief peculiarities:

(1) The proboscis sheath reaches to the end of the body, while (2) the thickened proboscis is but half as long; (3) basis of central stylet large, elongated; flattened or slightly concave posteriorly; (4) central stylet massive, not half the length of its basis; (5) ten or eleven proboscidial nerves; (6) body contractile, shape like *Amphiporus*, not as elongate as in *Emplectonema*; (7) ocelli numerous and small, extending along the nerve cords posterior to the brain.

While I am of the opinion that these characters are mainly of specific rather than of generic rank, yet I am convinced that because of the large number of species already in the genus *Amphiporus* the establishment of this new genus will be of great practical convenience. The most tangible characters of the group are: (1) the eyes extend posteriorly beyond the brain along the lateral nerve cords, and (2) the

¹Trans. Connecticut Acad., VIII, p. 20, 1892.

²Zool. Jahrb., x, p. 2 to 4, 12, 1897.

basis of the central stylet is massive and has a concave or a truncated posterior end, while the stylet itself is comparatively weak. Of course the number of nerves in the proboscis cannot be considered a generic character. There are two Alaska species, then, which may be placed in the genus—*Z. thalassina*, which is closely allied to the type species, and *Z. albida*, which is a minute, white form.

8. ZYGONEMERTES THALASSINA sp. nov.

Pl. II, fig. 5; Pl. VII, fig. 1; Pl. XIII, fig. 2.

Zygonemertes thalassina differs from *Z. virescens* chiefly in the following peculiarities: Color of former species much darker; eyes more numerous; shape of basis and central stylet of proboscis different; usually 5 stubby stylets in each lateral pouch, and 12 nerves in proboscis. There are minor differences in other anatomical details.

Zygonemertes thalassina has a slender, somewhat flattened body; head broad, not sharply marked off from body; one or two pairs of very inconspicuous oblique furrows on sides of head. The worms are active, and are restless in confinement.

Ocelli.—Ocelli very numerous; arranged in two or three longitudinal rows along sides of head, and extending backward along lateral nerve cords far behind brain. They are smaller posteriorly than in front and are more widely scattered. In front of the brain there are sometimes 40 or more ocelli arranged in two or three irregular rows (fig. 5) which follow the general outline of the lateral margin of the head. Immediately in front of the brain about a half dozen much smaller eyes are seen, and lateral to the brain are commonly 10 to 12 ocelli of moderate size. Behind these are usually 8 to 15 small ocelli scattered along the nerve cords at irregular intervals. These commonly reach nearly as far behind the brain as the distance from the brain to the tip of the snout in moderate extension. In sections (Pl. XIII, fig. 2) they are found to lie quite internal to the body musculature and almost directly upon the lateral nerves.

Size and color.—The specimens obtained were from 30 to 60 mm.

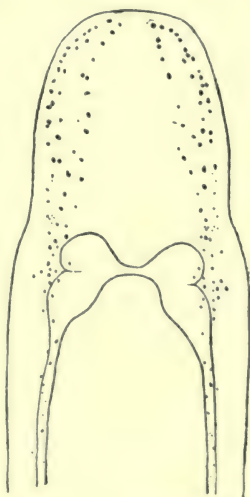


FIG. 5. *Zygonemertes thalassina*. Dorsal view of head showing outline of brain and lateral nerves, and arrangement of ocelli. $\times 12$.

in length in moderate extension, and rather slender. The color was olive-green both above and below. A coating of brown particles was sometimes scattered over the dorsal surface. The proboscis is pale.

Proboscis.—The proboscis sheath extends to posterior end of body; the proboscis extends only about half way to posterior extremity. The central stylet is remarkably short and blunt. Its basis (pl. VII, fig. 1) is at least twice, and often three times, as long as the stylet itself, and is massive in proportions. Its diameter is nearly constant throughout its length, although it is narrowed in front and constricted slightly at about three-fourths the distance towards its posterior end. The posterior extremity is sharply truncate or concave and often shows serrated edges (pl. VII, fig. 1). There are two lateral pouches of accessory stylets, and each usually contains five stylets similar in size and shape to the central stylet. The character of these remarkably stubby stylets is shown in pl. VII, figures 1a and 1b.

The lateral stylet pouches are imbedded in a thickened glandular wreath, yellowish in color, which lies around the circumference of the proboscis in front of the stylet. The mass of muscular tissue surrounding the basis of the central stylet is unusually thickened, and this necessitates an unusually long canal leading from the posterior chamber to the stylet region. In each of the two specimens sectioned the proboscis was provided with 12 nerves.

Cerebral sense organs.—Situated immediately in front of brain, but in the ventral portion of the head. The canals leading to the exterior pass obliquely forward and downward, and open on the antero-ventral surface near the tip of the snout.

Nephridia.—The nephridia extend from a point immediately in front of the brain backward throughout nearly the whole length of the esophageal region. There is a single pair of efferent ducts situated in the region of the brain, and opening to the exterior on the ventro-lateral aspects of the body. In the specimens examined one of these ducts lay as far forward as the ventral commissure of the brain, while the other was situated opposite the posterior end of the ventral brain-lobe.

Montgomery¹ mentions for *Z. virescens* that the superficial epithelium of the body contains numerous yellowish, sickle-shaped bodies situated among the epithelial cells. These also occur in *Z. thalassina*, but here they are of various sizes, and differ greatly in shape. Some are sickle-shaped, others are rod-like or irregular in form, and have every appearance of having been formed in the gland cells of the epithelium.

¹ Zool. Jahrb., x, p. 2, 1897.

Somewhat similar bodies may be found in various other Metanemerteans, notably in *Amphiporus bimaculatus* and *A. leuciodus*. Here too they appear to originate as secretions in the glandular cells of the epithelium.

The lateral nerve cords unite above the posterior end of the alimentary canal as usual.

The tissues of the head in front of the brain contain large numbers of sub-muscular glands which open mainly on the anterior extremity, although a portion of them open directly outwards. These sub-muscular glands do not extend back into the esophageal region as they do in many other species.

The intestinal cæcum is paired from its origin. Its two branches extend forward on each side of the esophagus until they reach nearly to the brain. Here they bend dorsally (Pl. XIII, fig. 2) and terminate by abutting closely against the posterior ends of the dorsal brain-lobes.

The ova are large and opaque. They appeared to be fully mature in June.

Habitat.—This species was found only at Sitka, where it was not uncommon among hydroids, broken shells, etc., in clear water.

9. ZYGONEMERTES ALBIDA sp. nov.

Pl. III, fig. 2; Pl. VIII, fig. 5.

This is a small, moderately slender species, very active in habits. It was met with only at Victoria, B. C., on the piles of a wharf. Sexually mature individuals were not more than 25 mm. in length. It was associated with *Amphiporus leuciodus*, which it somewhat resembles.

Color.—There are no markings on the body, the color being white with a tinge of yellow both above and below.

Ocelli.—This species may be easily recognized from other described forms by the arrangement of the eyes (fig. 6). These are scattered somewhat irregularly on the head in front of the brain, and extend backward as a single row on each side along the lateral nerves for about two-fifths the length of the esophageal region. The ocelli on the head are roughly arranged in two irregular rows on each side. There is an outer row

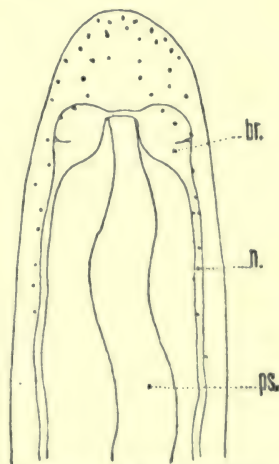


FIG. 6. *Zygonemertes albida*. Outline of anterior portion of body to show arrangement of ocelli. *br.*, brain; *n.*, lateral nerve; *ps.*, proboscis sheath. $\times 12$.

of 9 to 12 eyes near each lateral border of the snout, and another row inside and somewhat posterior to the latter, containing about 6 small ocelli on each side, and of these 3 commonly lie nearly above the brain. Back of the brain 7 to 10 ocelli occur at widely separated intervals above the lateral nerve on each side.

Proboscis.—Proboscis comparatively large; central stylet moderately slender; basis dark, moderately elongated, of nearly uniform diameter throughout, and sharply truncated posteriorly (Pl. VIII, fig. 5). Accessory stylet pouches two in number, each commonly containing two or three moderately slender stylets.

Cerebral sense organs.—Large, and situated immediately in front of brain.

The eggs of these worms are few in number, but are fully $\frac{1}{3}$ the diameter of the body in size; consequently there can be but a single row on each side. The sexual products are mature in June.

Paranemertes gen. nov.

Body of large size, rather stout, usually much rounded in the esophageal region but flattened posteriorly. Head not marked off from body, of variable form, in some states of contraction often emarginate in front. There is commonly a pair of inconspicuous oblique furrows back of head. The nerve cords and blood vessels join on the dorsal side of the posterior end of the intestine.

The mouth opens into the rhynchodæum. The proboscis sheath commonly reaches but little beyond the middle of the body—in *P. peregrina* to $\frac{3}{4}$ the distance towards the posterior extremity. The proboscis is small (*P. pallida*), of medium size (*P. peregrina*), or large (*P. carnea*). There is a single central stylet in the proboscis, and usually four or more pouches of accessory stylets. Some individuals of *P. peregrina*, however, have but two. Ocelli are numerous and minute. The cerebral sense organs are rather small and lie in front of the brain. Sub-muscular glands are usually well developed.

The species of this new genus show considerable resemblance to those of *Emplectonema* Stimpson. They differ, however, in general shape and appearance of body, never being very long or slender, and individuals do not coil their bodies into a mass as those of *Emplectonema* are so prone to do. The proboscis is much larger and the central stylet is always well developed. The proboscis sheath is also much longer. In many respects the genus resembles *Amphiporus*. The body is much longer, however, and not nearly so contractile, the proboscis is not nearly so large, and the proboscis sheath is not so long.

The armature of the proboscis resembles that in some species of *Amphiporus*.

Paranemertes is represented on the coast of Alaska by at least three species.

10. *PARANEMERTES PEREGRINA* sp. nov.

Pl. II, fig. 6; Pl. III, fig. 5; Pl. VII, fig. 7.

Body moderately elongated, flattened below, rounded on dorsal surface; anterior portion slightly more slender than middle region; posterior tapering gradually to extremity.

Head very variable in shape, commonly wider than the portion of body immediately following; flattened, sometimes sharply demarcated by lateral constrictions. Tip of snout pointed, rounded, or emarginate according to the state of contraction. On each side of the head is an inconspicuous V-shaped furrow, with the ends pointing obliquely forward above and below. The upper limb of the furrow reaches into the dark color of the dorsal surface, where it is sometimes conspicuous from its light color.

Color.—The color varies considerably as may be seen from a comparison of Pl. II, fig. 6, and Pl. III, fig. 5, but is commonly homogeneous dark brown, orange brown, or purplish brown above and on the sides, while the ventral surface is opaque white or whitish yellow. In most specimens the dark purple of the dorsal surface encroaches considerably on the ventral surface, shading gradually into whitish or yellowish. Seen from the ventral surface therefore the worms appear dull white or yellowish white, with a wide border of dark purple. Oftentimes the whitish color occupies scarcely more than the median third of the ventral surface. Anteriorly the whitish color covers the whole ventral surface, and on the head it covers also the sides and front. The head is dark purplish brown above, bordered in front and laterally by the light color of the ventral surface. At the posterior border of the head is a small angular spot on each side corresponding in color with that of the ventral surface. Behind the head is a narrow, V-shaped, dorsal marking, usually of lighter color, with its ends pointing forward and outward. In paler individuals the pinkish color of the brain lobes can be distinguished. The natural color of the body is well retained in formalin or alcohol.

Size.—Individuals of all sizes from 20 to 400 mm. were met with, but the most common size was about 150 mm. in extension. The width was commonly about 5 mm.

Ocelli.—Numerous minute eyes are arranged in two groups on each side (fig. 7). Of these, an anterior group of 12 or more small pigment spots are scattered along each side of the antero-lateral margin, while about as many more occupy an irregular cluster on each side just in front of the brain. These latter ocelli are usually well separated from the anterior, or marginal groups.



FIG. 7. *Paranemertes per-egrina* Outline of anterior portion of body to show the arrangement of ocelli. Dorsal surface. $\times 6$.

Proboscis.—Proboscis of medium size (as in *Amphiporus*), slightly yellowish, and usually everted when the animal is killed. The extruded proboscis is short and thick with an unusually slender posterior chamber. The armature (Pl. VII, fig. 7) consists of a small, slender, sharply pointed central stylet, and with either 2 or 4 pouches of reserve stylets. The basis of the central stylet is very small and slightly enlarged posteriorly; the reserve stylets are slender and sharp like the central one, and commonly number from 6 to 10 in each pouch. When four pouches are present the number of stylets in each is as great as when there are only two pouches.

The mouth and proboscis open together, but the rhynchodæum is short. The proboscis sheath reaches about three-fourths the length of the body, or sometimes more than three-fourths. In each of four specimens sectioned there were 14 conspicuous nerves in the proboscis. The proboscis has a remarkably narrow ring of gland cells on the periphery near the posterior end of the basis of the central stylet.

A crowded mass of multicellular glands occupies the anterior portion of the head. The anterior ones open on the tip of the snout. In the brain region they open mostly on the lateral surfaces of the body, while farther back, and in the esophageal region, they assume the character of sub-muscular glands. No difference in appearance is noticeable between the cephalic glands and those in the esophageal region. They are present in the esophageal region only about as far back as the openings of the nephridia. Throughout their course they open to the exterior (by innumerable ducts which pass through the muscular and basement layers) on the ventro-lateral aspects of the body.

Alimentary canal.—A pair of slender branches of the intestinal cæcum reach forward nearly to the brain commissures and lie well above the lateral nerve cords. At about the point of the nephridial openings these branches pass ventrally and occupy a position beneath the esophagus. Another pair, coming forward from behind, take

their places. The ventral branches join to form the main median cæcum, from which short branches pass obliquely forward and dorsally at intervals. In cross section two pairs of branches are usually seen besides the main cæcum. One pair of these lies above and one below the lateral nerves. They are disposed in such a way that one pair ends at about the point where the second pair anteriorly originates. The branches are only irregularly arranged in pairs. The esophagus opens into the dorsal wall of the main cæcum.

Nephridia.—The nephridia occupy the anterior $\frac{2}{3}$ of the esophageal region. They are large, with numerous branches lying above the lateral nerves, and frequently passing internally to the nerves and beneath the esophagus. They reach forward nearly to the brain. At about $\frac{1}{3}$ of their distance posteriorly the main nephridial tubes, lying above the lateral nerves increase greatly in size and a pair of remarkably large efferent ducts pass externally to the lateral nerves to open on the lateral aspects of the body slightly below the lateral margins. The main duct reaching posteriorly from this point is larger than that in front.

Blood vessels.—There is a pair of large blood lacunæ in the head as usual; they join anteriorly by a broad anastomosis. The three longitudinal vessels are well developed to the end of the body where they anastomose above the anus. Sometimes the dorsal vessel lies beside or even above the proboscis sheath throughout a portion of its course, instead of below the sheath as usual.

Nervous system and sense organs.—The cerebral sense organs lie well in front of the brain, and external to the blood lacunæ. They open into a slight furrow on the lateral aspects of the head a little anterior to their own position. The lateral nerves form a commissure above the anus as usual.

Reproductive organs.—The sexual products were nearly mature in June and July. They are formed in numerous pouches which surround the intestinal canal on all sides. In a male as many as twenty sexual pouches were seen in a single section. They open directly to the exterior, whatever be their position.

Habitat.—This is a restless Nemertean, and on cloudy days was frequently met with crawling about over the stones on the beach between tides—which peculiarity has suggested its specific name. It was found abundantly at nearly all the collecting stations from Victoria, B. C., to Unalaska Island, and is one of the commonest Nemerteans of the coast. It occurs from low tide well up toward high water mark in every variety of location—under stones, among seaweeds, barnacles, mus-

sels, etc. The individuals are very voracious feeders, and were taken not infrequently with partially swallowed Chætopods. Their tenacity of life is remarkable—they will live for days in a small quantity of filthy water.

11. PARANEMERTES PALLIDA sp. nov.

Pl. VII, fig. 3; Pl. XII, fig. 1.

Body rather large, stout, rounded, and almost cylindrical anteriorly, somewhat flattened behind when extended; head variable in shape, not sharply marked off from portions immediately following, at certain states of contraction emarginate in front. A pair of inconspicuous oblique furrows back of head. When contracted the worms are nearly cylindrical and of about the same diameter throughout, except at the extremities, both of which are pointed.

Color.—The whole body, both above and below, is commonly uniform opaque white, sometimes showing traces of yellowish or reddish tints, especially in the anterior portions.

Ocelli.—Ocelli minute and numerous. In ordinary states of contraction they are arranged in a pair of elongated, irregular clusters on the antero-lateral margins of the head. The number of such ocelli is sometimes 30 or more in each of the two clusters.

Proboscis.—Small, short, and unusually slender (Pl. XII, fig. 1). Its armature consists of a moderately slender central stylet and usually 4 pouches of accessory stylets. The basis of the central stylet is moderately slender, slightly constricted near its middle portion, rounded behind, and of approximately equal length with the stylet (Pl. VII, fig. 3). There are commonly two accessory stylets in each of the 4 pouches. The chambers posterior to the stylet apparatus are remarkably narrow.

The mouth opens into the rhynchodæum. The proboscis sheath extends but little beyond the middle of the body, and sometimes not so far as the middle. One specimen had 9 nerves in the proboscis; another had 10. These nerves do not all enter the proboscis from the ventral side, as they do in *Amphiporus angulatus*, but those supplying the dorsal portion enter direct from that side.

Closely packed *sub-muscular glands* are present on the right and left sides of the body, and extend well inward towards the median line. Their ducts pierce the musculature and other layers of the body walls mainly on the latero-ventral aspects of the body. Twenty or more are frequently met with in a single section. These glands occupy also the region in front of the brain, and extend backward in decreasing

numbers to the commencement of the intestinal region. In front of the brain is a large and irregular cluster of glands, which open anteriorly on the tip of the snout.

Cerebral sense organs.—Situated in front of brain, and near latero-ventral margins of head. The ducts which place them in communication with the exterior run obliquely forward and downward, and open immediately on the surface.

Nephridia.—The nephridial canals extend from near the brain throughout almost the entire esophagal region. The main trunks lie above the lateral nerve cords, and send off numerous branches both ventral and dorsal to the nerves. There is a single pair of remarkably large efferent ducts opening just below the lateral margins of the body, and slightly anterior to the middle of the esophagal region. In one series of sections these ducts are so precisely paired that both appear in a single section (Pl. XII, fig. 1). The efferent ducts pass from above obliquely downwards and external to the nerve cords.

The blood-vascular system consists of cephalic lacunæ, and anastomosing longitudinal vessels, as in related genera.

The intestinal cæcum does not reach forward nearly to the brain. There are comparatively few lateral diverticula (Pl. XII, fig. 1).

The lateral nerve cords unite above the posterior end of the intestine.

Paranemertes pallida was found only at Yakutat and at Sand Point on Popof Island, and few specimens were obtained. These were about 150 mm. to 250 mm. in length, and perhaps 5 mm. in width. They were found between tides under stones covered with algæ.

12. *PARANEMERTES CARNEA* sp. nov.

Pl. III, figs. 3, 4; Pl. VII, fig. 4; Pl. VIII, fig. 7.

This species was found to be extremely variable in size, shape of body, and head, and especially in the armature of the proboscis. As shown in Pl. III, figs. 3 and 4, the body is rather stout, rounded in the esophagal region, flattened both above and below posteriorly, and ending rather abruptly behind. The head is very variable in shape, being pointed, rounded, broadened, or emarginate in front, according to its state of contraction. It is most commonly a little broader than the parts immediately following, and is not distinctly marked off, although a slight oblique furrow on each side is sometimes seen behind the brain. From the dorsal surface the furrows of the two sides give the appearance of a very faint V-shaped marking with the angle projecting backward in the median line. A little farther forward, as seen in Pl. VIII, fig. 7, a pair of shallow furrows occupies the sides of

the head. These are also V-shaped with the angle projecting backward on the lateral margins. The ventral limb of each V-shaped furrow reaches nearly to the opening of the rhynchodæum; on the dorsal surface the ends of the dorsal limbs are separated by about $\frac{1}{3}$ the diameter of the body in ordinary states of contraction (fig. 8).

In microscopic sections the V-shaped grooves on each side of the head are conspicuous, because of their differentiated epithelium. In these shallow depressions the epithelial cells are of smaller size, more slender in form, and seem to partake more of the nature of sensory cells. In these grooves the ordinary glandular cells are wanting. In the ventral limb of each V-shaped groove opens the tube which places the cerebral sense organs in communication with the exterior.

Ocelli.—There are commonly 20 to 32 eyes on the head arranged in 4 more or less distinct clusters, though their relative positions change with the contraction of the head. The two anterior clusters contain about 4 to 6 eyes each, and occupy the antero-lateral margins of the head (figs. 8, 9). The posterior clusters lie directly back of these,



FIG. 8.



FIG. 9.

FIGS. 8 and 9. *Paranemertes carnea*. 8. Outline of head from dorsal surface showing arrangement of ocelli. The two pairs of lateral indentations indicate the lateral and dorsal furrows. $\times 8$. 9. Outline of the head when extended. Dorsal surface, showing arrangement of ocelli. $\times 6$.

and immediately in front of the brain. Each of these clusters contains 8 to 12 scattered ocelli. An individual from Taku Harbor had 6 ocelli in each anterior cluster, and 10 in each posterior one. Another specimen had only 3 or 4 eyes in each of the four clusters, but in this case the ocelli were larger. A specimen from Popof Island had 3 large eyes in each anterior, and 6 to 8 in each posterior cluster; one from Virgin Bay had 6 in each anterior, and 7 in each of the others,

and had 3 single eyes between the anterior and posterior clusters, while one from Yakutat had 3 large ocelli in a row on the anterior margin of the head, and a pair of scattered clusters of 8 to 12 eyes each in front of the brain. When the head is contracted so that it is emarginate in front, the arrangement of the eyes into clusters disappears, and they are then all scattered irregularly on the antero-lateral margins. Figs. 8 and 9 show the general arrangement of the eyes.

Color.—The whole body, both above and below, is a homogeneous, very pale red or flesh-color (Pl. III, figs. 3, 4), and is entirely without markings except for a longitudinal median line of deeper red, showing the position of the proboscis sheath, and the deeper color of the intestinal lobes. In some specimens the reddish color was more pronounced anteriorly, and some were very pale. The intestinal lobes are seen through the clear tissues of the body walls as narrow, transverse markings, slightly darker than the rest of the body. The reddish color of the brain and lateral nerves is often conspicuous from the dorsal surface (Pl. III, fig. 3).

Size.—Individuals were seen which were 500 mm. long in greatest extension, although the majority were less than half this length.

Proboscis.—Mouth and proboscis open together through a subterminal pore. The proboscis is large (Pl. VIII, fig. 7) and of moderate length. The short proboscis sheath does not reach far beyond the middle of the body. The armature of the proboscis shows marked variations. The size and shape of the central stylet and its basis, however, remain fairly constant. The central stylet is of the regular *Amphiporus* type, is moderately slender, and rests on a moderately slender basis. The basis is slightly narrower in front and is rounded behind (Pl. VII, fig. 4). The number of pouches of accessory stylets is commonly from 6 to 12. One specimen had 12 of these pouches, each with one or two slender stylets; each of two others had six pouches with two stylets in each pouch. Three specimens had each twelve nerves in the proboscis, while a fourth specimen had but eleven.

Cerebral sense-organs.—Unusually small and situated some distance in front of brain-lobes. They occupy positions very close to the ventro-lateral borders of the head, and beneath the cephalic blood lacunæ.

Nephridia profusely branched, and extending throughout the greater portion of esophageal region, though they do not reach the brain. Their numerous branches ramify both above and below the lateral nerve-cords, and several efferent ducts of small size lead to the exterior from both the dorsal and ventral branches. There may be about five

pairs of efferent ducts, all of which open in the immediate vicinity of the lateral nerves. In one series of sections a small efferent duct from one of the branches above the lateral nerve was followed only two sections farther back by a similar, though larger, duct from a branch below the lateral nerve on the same side. The nephridia end posteriorly near the point where the esophagus opens into the intestine.

Sub-muscular glands of limited number lie between the musculature and the intestine and proboscis sheath. These glands are closely packed together in the head in front of the brain; back of this point they become widely scattered, although they do not cease entirely until back of the esophagal region.

A short intestinal cæcum with a few wide lateral diverticula extends forward beneath the esophagus. This cæcum is shorter than in most species of the genus, and does not reach nearly to the brain. The esophagus also is short and opens directly into the dorsal wall of the intestine.

A pair of large blood lacunæ occupies the anterior portion of the head as usual.

The lateral nerves and longitudinal blood vessels join above the posterior end of the alimentary canal, as in most species.

Reproductive glands in both male and female are very numerous, and are situated both above and below the intestine. They open directly to the surface, as could be determined from their rudimentary ducts, although the sexual products were very immature in June and July.

Habitat.—This species is conspicuous because of its clear, rosy or flesh-like color, which is all the more striking in contrast with the black mud in which it is usually found. It occurs between tides in muddy locations over a large portion of the southern Alaska coast. It was collected at Taku Harbor, Sitka, Yakutat, Prince William Sound, and Popof Island, although only a few were found at each locality. Usually but one or two specimens were found in several hours' digging.

Amphiporus Ehrenberg.

Symbolæ Physicæ, Berlin, 1831.

This is by far the most common genus on the Alaska coast, and to it belong six of the thirty species of Nemerteans collected.

The genus *Amphiporus* includes mostly rather stout, solid, often flattened forms, usually of considerable size, which are capable of an almost incredible amount of extension and contraction. A few forms, however, are long and cylindrical, even when contracted, but others

can contract until the body becomes almost barrel-shaped. The worms can neither swim nor roll up spirally.

Proboscis.—Provided with a single, well-developed central stylet, with a cartridge-shaped basis, and with two or more pouches of accessory stylets. The proboscis sheath usually reaches nearly or quite to the end of the body.

Ocelli.—Usually present in very considerable numbers. A few forms are without eyes, and a few others have but a single pair—there are never 4. The eyes do not extend far behind the brain.

Cerebral sense organs.—Usually well developed. Their position is most commonly in front of the brain, but they are sometimes beside or even behind the ganglia.

13. AMPHIPORUS ANGULATUS (Fabr.) Verrill.

Pl. VI, fig. 4; Pl. VII, figs. 2, 2a; Pl. XI, fig. 2; Pl. XIII, fig. 3.

Fasciola angulata O. FABRICIUS, Müller's Verm. Terrest. et Fluv., I, p. 58, 1774.

Omatoplea stimpsonii GIRARD, in Stimpson, Invert. of Grand Manan, Smithsonian Contributions to Knowledge, p. 28, 1853.

Nareda superba (?) GIRARD, loc. cit.

Cosmocephala beringiana STIMPSON, Proc. Acad. Nat. Sci. Philadelphia, p. 165, 1857.

Amphiporus angulatus (FABR.) VERRILL, Marine Nemerteans of New England, Trans. Conn. Acad., p. 10, 1892.

"This large and conspicuous species is generally easily recognized by its clear dark purplish or chocolate-brown color above, with pale margins and a trapezoidal or triangular white spot on each side of the head and usually with a narrow white line across the neck; and by the pinkish or flesh-colored lower surface. Ocelli in two or more rows in an elongated groove on each antero-lateral margin of the head, and a pair of small sub-dorsal clusters on the transverse white nuchal band." (Verrill, loc. cit.) The arrangement of the eyes and markings on the head of the Alaska specimens are shown in fig. 10 and in Pl. VI, fig. 4. In ordinary state of contraction the body is rather short and stout. When disturbed it can become so greatly thickened anteriorly that its transverse diameter is fully $\frac{1}{3}$ as great as its length. In extension the body is but moderately elongated, and is relatively broad and flat. It contracts very much as does a leech.

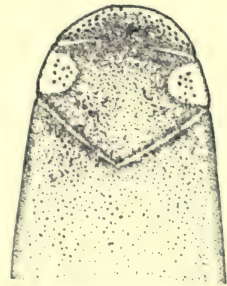


FIG. 10. *Amphiporus angulatus*. Dorsal view of anterior portion of body showing markings on the head and the arrangement of ocelli. $\times 8$.

The Alaska specimens are commonly larger than have been recorded elsewhere, often measuring 200 mm. or more in length and 10 mm. in width.

Proboscis.—The proboscis is large, thick, and pale reddish or salmon in color. The smallest specimen collected had 17 nerves in the proboscis; four other specimens examined had each 18 proboscicial nerves, one had 19 nerves, and two others had 20 each.¹ This shows more strikingly than has previously been pointed out that the number of nerves in the proboscis is variable to a very considerable extent. Bürger² has shown that *Drepanophorus crassus* may have 19 or 20 nerves, and *D. spectabilis* 24 or 26. Nevertheless in the other Alaska species the number has been found surprisingly constant. The number of nerves in any particular proboscis remains perfectly constant so far as I have observed from the anterior end back as far as the stylet region. Here they break up into a plexus and lose their identity. The nerves in *A. angulatus* enter the proboscis at its anterior attachment and in its ventral portion (pl. xi, fig. 2). They then divide into their definite number of branches (usually 18) which pass obliquely dorsally and arrange themselves symmetrically on the periphery. The proboscis sheath extends within a few sections of the posterior end of the body.

The armature of the proboscis is made up of a moderately slender central stylet, and (usually) two pouches of accessory stylets. The basis of the central stylet is about as long as the stylet itself. It is moderately slender, constricted near its middle (pl. vii, figs. 2, 2a), enlarged and rounded posteriorly. Each reserve pouch commonly contains 5 to 7 rather slender stylets, similar in size and shape to the central stylet.

Ocelli.—Numerous and characteristic in arrangement. The dark pigment on the head, however, often renders them difficult of accurate determination. Girard³ states for *Omatoplea stimpsonii* that there are six or more minute eyes "situated in an oblique, simple row, on either side of the head anteriorly." The same author (loc. cit.) describes

¹Of eight specimens of this species from Eastport, Maine, one had but 17 nerves in the proboscis, six had 18 each, and one had 19 or 20. Other anatomical details in the eastern form agree perfectly with those of specimens from Alaska. I have recently examined a number from the original locality of Stimpson's *C. beringiana* (Bering Strait), and have no doubt as to the specific identity of this form with that from southern Alaska and from Eastport, Maine.

²Fauna u. Flora des Golfes von Neapel. Monogr. 22, Nemertinen, p. 372, 1895.

³Marine Invert. Grand Manan, Smithsonian Contr. to Knowledge, p. 28, 1853.

Nareda superba as having but a single pair of rounded ocelli situated wide apart on the transverse white band of the neck. It seems highly probable, as Verrill suggests,¹ that both of the species are identical; in the one case only the marginal eyes were seen, while in the other the cerebral clusters were supposed to represent single eyes and the marginal ones were overlooked. Verrill¹ describes the eyes correctly, and his diagnosis of the species is so full and accurate that it is necessary to describe here the internal anatomy only. A pair of elongated clusters of ocelli lies on the antero-lateral margins of the head, and another smaller cluster on, or near, the angular white spot on each side of the head. As shown in fig. 10, each of the anterior clusters may contain upwards of 20 ocelli arranged in two or more irregular rows nearly parallel with the antero-lateral margin of the head, while the posterior groups may consist of 8 to 15 similar ocelli. The posterior groups are situated deep in the tissues of the head. Of course the number of ocelli varies greatly in different individuals.

Cerebral sense organs.—Well developed. They lie a little in front of the brain, beside the esophagus, and below the cephalic blood lacunæ. Each *sense organ* has a wide canal which leads a short distance anteriorly and opens to the exterior on the latero-ventral aspect of the body. The brain itself is of large size, with a thick ventral and narrow dorsal commissure (Pl. XI, fig. 2).

Nephridia.—The nephridia extend from near the brain (Pl. XI, fig. 2) well backward in the esophagal region. In one specimen there were two pairs of efferent ducts opening on the latero-ventral aspect of the body; in another only one pair.

Cephalic glands.—The cephalic glands open on the tip of the snout and are well developed. Sub-muscular glands, likewise, are remarkably abundant. They reach from the brain region well back towards the end of the esophagus. They are multicellular, each one being composed of upwards of a score of large, vacuolated cells with small nuclei situated on the side farthest from the lumen. Each gland has a twisted duct leading through the muscular layers, basement membrane, and integument, and opening to the exterior on the ventro-lateral aspects of the body (Pl. XI, fig. 2).

Beneath the esophagus a broad cæcal appendage of the intestine stretches forward well toward the brain region. This cæcum consists of a large median canal with pouch-like diverticula extending dorsally above the lateral nerve cords.

There is the usual anastomosis of the three longitudinal vessels, and

¹ Marine Nemerteans of New England, Trans. Conn. Acad., VIII, p. 12, 1892.

of the pair of lateral nerve cords (Pl. XIII, fig. 3), above the hind gut and slightly in front of the anus. As seen from the figure, the union of the blood vessels is directly dorsal to that of the nerve cords.

The reproductive glands occur both above and below the alimentary canal. Sexual products were not nearly mature in June and July.

Habitat.—The species is extremely abundant along the whole Alaska coast as far west as Unalaska Island, and Stimpson records it from Bering Strait. It is found under stones between tides in all sorts of situations. Stimpson's specimens came from a depth of five fathoms. The species is found on the Atlantic coast of North America from Massachusetts Bay to Greenland (Verrill, *loc. cit.*).

14. AMPHIPORUS BIMACULATUS sp. nov.

Pl. I, fig. 4; Pl. V, fig. 10; Pl. VIII, fig. 2; Pl. XII, fig. 2.

Body rather short, broad, and flattened both above and below. Head narrower than parts immediately following. Body of about the same width and thickness throughout esophageal and intestinal regions. Posterior extremity tapers rather abruptly to the pointed or rounded end. Opening of rhynchodæum situated on subterminal portion of snout. From near this opening a pair of slits pass obliquely backward and upward behind the eyes to the brain region.

Color.—The color of this species is very striking. The whole dorsal surface back of the head is deep brownish orange, somewhat paler behind. The head is without color, or of a very much paler color than the rest of the dorsal surface, and in the center of this pale area two oval, black or very dark brown spots lie side by side. These are very characteristic, and are conspicuous even in alcoholic specimens. The black spots sometimes occupy a considerable portion of the pale area, and are sometimes sharply angular in front (Pl. I, fig. 4). In the median line of the body the color is slightly paler than elsewhere and in the center of this paler stripe is a dark, but inconspicuous, longitudinal line. The pale stripe and dark line both fade out at a point about $\frac{1}{6}$ the distance towards the posterior end of the body. The brain lobes appear as pinkish bodies just posterior to the black cephalic spots. The whole ventral surface is of a homogeneous, pale orange or flesh color, with the exception of pinkish spots marking the position of the brain, and a slightly paler stripe below the anterior portion of the proboscis sheath.

Ocelli.—The eyes are rather large, and number 25 to 30 or upwards on each side (fig. 11). The majority lie in an irregular marginal row beside and in front of each of the black cephalic spots. At

the posterior end of each marginal cluster the ocelli are more closely and more irregularly placed, and often occupy several rows. In addition to these marginal clusters a closely set group of about a half dozen smaller ocelli is situated in the light area lateral to the posterior end of each of the dark cephalic spots. These ocelli lie deeper in the tissues of the head, and near the brain (Pl. I, fig. 4).

Proboscis.—The proboscis is remarkably large, and its constituent layers are very sharply defined (Pl. XII, fig. 2). The proboscis sheath has a correspondingly massive development, and reaches to the very extremity of the body. The stylet apparatus of the proboscis is very characteristic of the species, because of the extreme minuteness of the basis of the central stylet. The central stylet itself is very long and slender, while the length of its basis is but half as great. The basis is constricted in the middle, and is $\frac{2}{3}$ as wide as long (Pl. VIII, fig. 2). There are usually four pouches of accessory stylets. These pouches are not evenly distributed on the circumference, for two lie close together on one side of the proboscis, the other two on the opposite side. There are usually five to seven slender stylets in each of the four pouches.

Most of the stylets are much smaller than the central stylet. Measurements of the stylets of one individual about 100 mm. long are: central stylet .12 mm. long, .015 mm. wide near base; basis of central stylet, .06 mm. long, .04 mm. wide; largest accessory stylet, less than .1 mm. long. The proboscis is provided with 16 large nerves (Pl. XII, fig. 2).

The mouth and proboscis open together. There are three large communicating blood lacunæ in the head, one on the right, one on the left, and one dorsal to the rhynchodæum.

Cerebral sense organs.—Remarkable for their large size, being fully as large as either of the brain lobes. They lie lateral to the brain, slightly *behind* the commissures, and in the angle between the dorsal and ventral lobes. A large process from the posterior end of the dorsal lobe furnishes the sense organs of the same side with an abundant innervation. Their posterior ends extend backwards beyond the dorsal brain lobes, against the posterior faces of which they are closely pressed. Behind the dorsal brain lobe the sense organs lie directly dorsal to the lateral nerve-cords and are bathed on their internal borders by large blood lacunæ. A section through this point is not very different from a corresponding section of a *Heteronemer-*



FIG. 11. *Amphiporus bimaculatus*. Outline of head to show position of markings and arrangement of ocelli. $\times 8$.

tean. Of the Alaska *Metanemerteans* here recorded this is the only one in which the cerebral sense organs lie posterior to the brain commissures. The canal by which each sense organ communicates with the exterior is of large size, runs anteriorly in front of the brain, and opens on the ventro-lateral aspect of the head.

Nephridia.—The nephridia reach forward close to the posterior ends of the cerebral sense organs. Anteriorly there is a tangle of small vessels, but farther back these unite into a single large, branched canal which runs close beside the blood vessels above the lateral nerve on each side. From these canals a pair of large efferent ducts pass above the lateral nerve cord, and open to the exterior of the body just below the lateral margin.

Sub-muscular glands.—Present along anterior portion of esophageal region, but not very abundant.

A broad and profusely branched *intestinal cæcum* runs forward from the intestine well toward the brain region. The cæcum lies well beneath the esophagus and sends off numerous pouch-like branches dorsally above the lateral nerve cords.

Reproductive glands.—These occur both above and below the intestinal canal. Although the sexual products were very immature in one of the specimens sectioned, yet the efferent ducts of the glands were formed as far outward as the basement layer of the cutis. Here each duct ended in a swollen chamber lined with cylindrical epithelial cells.

Size.—The individuals of this species varied from 40 to 150 mm. in length. The largest were about 6 mm. wide and 2 mm. thick.

Habitat.—The species was collected at Victoria, B. C., on the piles of the wharf; at Sitka among hydroids, etc., near low water (W. E. Ritter), and a finely preserved specimen from Puget Sound, State of Washington, was given me by Prof. Trevor Kincaid.

15. AMPHIPORUS TIGRINUS sp. nov.

Pl. IV, figs. 5-8; Pl. VIII, fig. 4; Pl. X, figs. 3, 4.

Body moderately slender, rounded throughout, head not marked off from parts immediately following, rather narrow and pointed in front; posterior extremity of body narrow. On each side of the head is a shallow, inconspicuous, oblique groove.

Color.—In June, at the time the specimens were collected, the sexual products were fully mature, and the species showed marked sexual color varieties. The prevailing color of the females was yellowish orange both above and below, but except in the esophageal region, this color was to a great extent obscured by the dark olive green

color of the mature ova. These ova developed in large pouches on each side of the body, and each pouch with its contents appeared as a dark green spot. In many cases several adjacent pouches lie nearly in contact, giving the external appearance of dark green blotches. Seen directly from the dorsal surface the green spots appear on each side in more or less regular pairs, those of the two sides being separated by an interrupted, narrow, longitudinal, median band of yellow. From the sides the ovaries appear as irregular transverse stripes of dark green alternating with the yellow color of the body—hence the specific name, *tigrinus*. The males are much less deeply colored. They are pale yellowish with a slight tinge of green, and the spermaries appear as innumerable cream-colored specks. Both males and females have a narrow, longitudinal, median band of brownish on the anterior dorsal portion of the body. After preservation in alcohol both sexes assume a greenish color, which is retained even after mounting in balsam.

Ocelli.—The eyes are numerous, and are arranged in two irregular, and scarcely separated, clusters on each side of the head in front of the brain. The individual ocelli are so irregular in shape, so variable in size, and so closely massed together, that it is difficult to determine their precise number. Many of them appear as ragged pigment masses. Commonly, however, there are a dozen or more of such ocelli in each of the anterior clusters, and perhaps 8 to 10 in each of the posterior ones. The ocelli of the anterior clusters are scattered through the tissues of the head from the dorsal to the ventral surface. Some of the ocelli are three times as large as are others. In contraction all the eyes of the same side form a single confused cluster. Because of their variability of position no drawing is given of their arrangement.

Proboscis.—The long and well developed proboscis is provided with a remarkably weak armature. This consists of a small central stylet and two pouches of accessory stylets. The central stylet is small and short, but is acutely pointed. Its massive basis, double the length of the central stylet itself, is short, thickened, and rounded behind (Pl. VIII, fig. 4). In a worm 75 mm. long, the central stylet measured about .075 mm. in length; the basis was .15 mm. long and .075 mm. in average diameter. The accessory stylets are, like the central stylet, short, broad at the base, but sharply pointed. They usually number about five to each pouch. The glandular wreath about the stylet is well developed, and in the specimens examined is deep green in color even after mounting in balsam. The proboscis sheath reaches nearly to the posterior end of the body.

Cerebral sense organs.—Smaller than in most species of the genus. They are situated slightly in front of the brain, but are well separated from it because they lie near the ventro-lateral border of the head. The canals placing them in communication with the exterior are, consequently, extremely short. Each canal opens into the shallow, oblique furrow on the side of the head. The posterior ends of the sense organs lie beneath the anterior borders of the ganglia, but much nearer the ventral surface. A pair of large nerves given off from the dorsal ganglia opposite their commissure connect with the sense organs. The lateral nerve cords unite above the posterior end of the intestine as usual.

The body cavity in the esophageal region is filled with an unusually large amount of gelatinous tissue, which occupies the considerable space between the muscular layers and the esophagus and proboscis sheath (Pl. x, fig. 4). In this gelatinous tissue the lateral nerves are situated, and through it a complex system of blood vessels and nephridial canals ramifies.

The intestinal cæcum is very broad and has but short lateral diverticula. It lies wholly beneath the esophagus, and the branches do not extend above the lateral nerves. The cæcum ends anteriorly far behind the brain region. The esophagus becomes very small before it empties into the dorsal wall of the broad intestine.

The attachment of the proboscis to the tissues of the head, the position of the rhynchodæum and its openings into the esophagus and proboscidal cavity, the position of the dorsal and ventral brain commissures, the cephalic glands and other organs are shown in Pl. x, fig. 4.

The sexual products are mature in June. The whole body becomes distended with the pouches of sexual elements, and the cavity of the alimentary canal is much reduced in consequence. The ova are large and deep olive-green.

The length of the specimens obtained, both males and females, was about 75 to 100 mm. in extension.

Habitat.—This species was met with only at Farragut Bay, where it occurred under stones in muddy locations at about half tide.

16. AMPHIPORUS NEBULOSUS sp. nov.

Pl. IV, fig. 1; Pl. VIII, fig. 6; Pl. XI, fig. 1.

Body short, rather broad, and much flattened; narrower anteriorly than in the intestinal region, and tapering gradually posteriorly. Mouth sub-terminal; head pointed or expanded in front, according to

state of contraction. A V-shaped furrow is present on each side of the head near the tip; the angles of these furrows point obliquely forward above and below.

Color.—Dull white or pale yellowish on dorsal surface; very thickly mottled with confluent dark brown blotches and dots which largely obscure the ground color. Margins of the head without spots. There are faint indications of a pair of transverse lines without color—one near the tip of the snout and the other near the brain region, the latter sometimes becoming a shallow, irregular, V-shaped furrow. Ventral surface dull white or yellowish, without markings other than deeper yellow spots which indicate the positions of the genital sacs, and the darker color of the intestinal canal.

Ocelli.—On each side of the head are from 18 to 25 ocelli, arranged in three irregular groups (fig. 12). Close to the anterior border of the snout are 4 or 5 large cup-shaped ocelli on each side. Behind these and bordering each lateral margin are about 8 much smaller eyes in an irregular group, while 3 or 4 small eyes are scattered between these and the anterior group. Behind each lateral group, and not far in front of the brain, about 7 to 10 small ocelli lie in an irregular cluster deeper in the substance of the head, and are therefore less easily visible.



FIG. 12. *Amphiporus nebulosus*. Outline of the head to show arrangement of ocelli. Dorsal surface. $\times 7$.

Size.—The specimens obtained measured 100 to 150 mm. in length, and 5 mm. in width. The esophageal region is short, rounded above, flattened below, and thicker than the intestinal region.

Proboscis.—The proboscis sheath reaches nearly to the extreme end of the body. Proboscis thick, fairly large, and white. It is provided with 17 nerves. Basis of central stylet very much broadened posteriorly (pl. VIII, fig. 6), flat or even emarginate behind, narrow in front. Central stylet as long as the basis, slender, acutely pointed. Accessory stylets in two pouches; similar to central stylet, but sometimes very slightly curved; commonly 3 in each pouch. The pouches lie well behind the central stylet in ordinary extension (pl. VIII, fig. 6). Wreath of gland-cells surrounding basis of central stylet moderately broad.

In the brain region (pl. XI, fig. 1) and for some distance posteriorly an abundance of large multicellular glands are thickly placed in the ventro-lateral aspects of the body, and are mostly situated among the fibers of the longitudinal muscular layer. Behind the brain these sub-muscular glands become so closely packed together that the muscular

layer is divided into an outer and an inner portion in the region where the glands are situated. The ducts from the glands (Pl. XI, fig. 1, *smg*) pass through the muscular layers and basement membrane to open to the exterior among the epithelial cells of the integument. These glands become smaller and more scattered near the region of the nephridial openings, but do not disappear entirely until near the end of the esophageal region.

Alimentary canal.—The mouth and proboscis open together into the rather long rhynchodæum. The esophagus is as usual in the genus. A single pair of small intestinal cæca reach forward well toward the brain region. They lie immediately below the esophagus, and near the middle line. Farther back they join a median, broad, unpaired cæcum. This has wide, paired, lateral outgrowths which, still farther back, alternate with clusters of reproductive glands. These lateral appendages of the cæcum lie mostly above the reproductive glands, as well as alternate with them. Much farther back the esophagus decreases greatly in size and opens into the intestine by a longitudinal slit in the dorsal wall of the latter. The intestinal pouches are rather deep; the anus is subterminal.

Nephridia.—The nephridial canals reach anteriorly nearly to the region of the brain, where there is a single branched longitudinal vessel on each side. Throughout the greater part of its length, this main canal lies above the lateral nerve cord, but sometimes lies internal to it or above it. In the anterior third of the esophageal region the main canal becomes very large; here an efferent duct branches off, passes outside the lateral nerve, and bends downward to open on the exterior of the body on the ventro-lateral aspect. There is but one efferent duct on each side, and the two are sometimes exactly paired. Back of the efferent ducts, the nephridial canals decrease rapidly in size, and disappear far in front of the anterior end of the intestinal region.

A pair of large blood lacunæ lie in the anterior portion of the head as usual. In the brain region they divide into numerous smaller vessels (Pl. XI, fig. 1). The lateral vessels form a broad anastomosis with the dorsal vessel above the anus.

Nervous system and sense organs.—The dorsal ganglia are closely fused with the ventral. They are without distinct posterior lobes, and sink gradually into the ventral ganglia (Pl. XI, fig. 1). The cerebral sense organs are well developed. They lie in front of the brain, some distance ventrally from the dorsal ganglia, and communicate with the exterior by a canal which opens ventro-laterally. Each sense organ is lobulated posteriorly and provided with a large nerve (*son*,

pl. xi, fig. 1) which arises from the ventral side of the dorsal ganglion near the ventral commissure. The union of the lateral nerve cords above the anus lies in the same section as the anastomosis of the three longitudinal blood vessels. A pair of small nerves from the lateral cords continues backward beyond the commissure to the end of the body.

Reproductive organs.—The sexual glands first make their appearance in the esophageal region at the point where the unpaired intestinal cæcum receives its pair of anterior branches. Those sexual glands which are situated most anteriorly lie below the alimentary canal, internal to the lateral nerves, and open on the ventral surface of the body. Farther back are commonly four or five reproductive pouches in a single section. These lie mainly below the intestine, but no matter what their position they all open to the surface of the body *below* the lateral margins. Those lying farthest from the middle line and above the lateral nerves open ventrally between the nerve cords and the lateral margins. Sexual products appear to be fully mature in July.

Habitat.—Beneath stones near low water at Kukak Bay, Alaska Peninsula (T. Kincaid).

17. AMPHIPORUS LEUCIODUS sp. nov.

pl. vii, fig. 6.

Body usually not more than 50 to 75 mm. in length, slender, elongated, flattened posteriorly, not capable of great contraction. Head narrower than parts immediately following. An inconspicuous V-shaped furrow on dorsal surface back of head, seen only under favorable conditions.

This species resembles young individuals of *A. exilis*, with which it is often associated. It is likewise similar in many respects to *A. lactifloreus* (Johnston) McIntosh, from which it differs widely in the armature of the proboscis and in many other anatomical features.

Color.—Opaque white, sometimes with a pale reddish or yellowish tinge. This color is commonly uniform throughout, though it is somewhat influenced by the internal organs which show through the body walls. The brain is pinkish, the intestine often brownish.

Ocelli.—There are four irregular, but usually distinct groups of minute ocelli on the anterior portion of the head. Bordering each antero-lateral margin of the tip of the snout is an elongated cluster of about 8 to 12 ocelli (fig. 13). Posterior to these marginal clusters,

and somewhat nearer the median line is a pair of clusters, each of which likewise contains 8 to 12 ocelli. These posterior groups lie immediately above the brain. Smaller and evidently younger individuals have but 4 to 6 eyes in each of the four groups. There is considerable variation in the size of the ocelli.

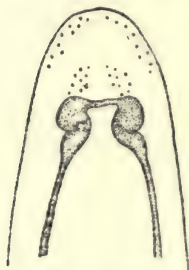


FIG. 13. *Amphiporus leuciodus*. Outline of anterior portion of the body showing brain and arrangement of the ocelli. $\times 12$.

Proboscis.—The proboscis sheath reaches nearly to the posterior end of the body. The proboscis is rather slender but may be contracted so that its diameter is equal to more than half that of the body itself. The proboscis is commonly attached to the proboscis sheath at a point situated from $\frac{1}{3}$ to $\frac{1}{4}$ the distance towards the posterior end of the body. The armature is weaker than in *A. exilis*. The central stylet is moderately slender and acutely pointed. Its basis is somewhat conical in shape, contracted slightly toward its middle portion (Pl. VII, fig. 6), and is rounded at its larger, posterior end. It is slightly longer than the stylet itself. The number of pouches of accessory stylets is commonly three, although there are sometimes only two, and occasionally a specimen is found which has four. There are usually two or three stylets in each pouch. In a few instances, however, four and five were observed. Where three pouches are present, as is usual, they are situated at nearly equal distances on the circumference of the proboscis (Pl. VII, fig. 6).

Cerebral sense organs.—Moderately small and situated well in front of brain and on ventral side of head. They communicate with the exterior by means of a pair of canals which open on the latero-ventral margins of the tip of the head.

Nephridia.—The nephridia reach forward to the brain region. There are several pairs of efferent ducts, some of which open on the ventral, and some on the dorsal surface of the body. In one of the specimens sectioned the first pair of efferent ducts extended from the internal side of the lateral nerve cords and opened directly to the latero-ventral aspect of the body after passing on the *ventral* side of the nerve cords. A little farther back in the esophageal region were two efferent ducts on one side and one on the other which passed above, and externally to the nerve cords to open likewise below the lateral margins. In the remainder of the esophageal region were three more efferent ducts on each side. With one exception all of these passed above the lateral nerves and opened on the dorso-lateral surfaces of the

body as in *A. exilis*. Another specimen had 7 efferent ducts on the left side and 8 on the right. Of those opening on the left side the four anterior ones passed dorsally to the nerve cord and then bent ventrally to open on the ventro-lateral aspect of the body; the fifth one opened very near the lateral margin, and the last two opened on the dorso-lateral surface. On the right side the four anterior ducts opened ventro-laterally, and the four posterior ones opened on the dorso-lateral surface. The nephridia extend backward beyond the first few pairs of reproductive glands. Here, then, we find the connecting links between the typical *Amphiporus* nephridium (which passes above and external to the lateral nerve and then bends downward to open on the ventro-lateral aspect of the body), and the type of nephridium which is characteristic of *A. exilis* and the Heteronemerteans, and which opens directly on the dorso-lateral aspect of the body.

Sub-muscular glands are closely packed together in front of the brain and in the brain region. They are not found farther posteriorly, and in this respect the species differs markedly from *A. exilis*.

The *intestinal cæcum* reaches forward well toward the anterior end of the esophagal region. The main cæcal cavity, which lies directly beneath the esophagus, sends off numerous lateral pouches above the lateral nerves, and at its anterior end branches into lateral diverticula which extend forward on each side as far as the brain region.

Reproductive glands.—The genital products mature in June in the region of Victoria, B. C. The ova develop in sacs which are regularly arranged, and extend from the posterior third of the esophagal region to the posterior end of the body. The ovaries, in all cases noticed, were situated immediately above the lateral nerves. In the intestinal region they alternate with the intestinal lobes with a great deal of regularity. Their efferent ducts occupy positions on the latero-dorsal aspects of the body exactly corresponding to those of the posterior efferent nephridial ducts. The ducts from the ovaries, however, pierced only the longitudinal muscular layer, and did not penetrate the circular muscular layer of the body wall. These rudimentary genital ducts are further distinguished from the nephridial ducts by lacking a conspicuous epithelial lining.

Habitat.—These slender whitish worms were found in great abundance beneath barnacles and other growths on the piles of the wharf at Victoria, B. C. They were found less abundantly under stones between tides at New Metlakhtla and in Glacier Bay, but were not noticed farther northwest.

18. AMPHIPORUS EXILIS sp. nov.

Pl. III, fig. 1; Pl. VII, fig. 5; Pl. XI, fig. 3.

Body extremely elongated for the genus, rounded throughout; not capable of the great contraction which characterizes many species of the genus; only moderately flattened; posterior extremity slender. Head usually narrower than esophageal region. The general shape of the body resembles that of *Emplectonema*. In shape of body, as



FIG. 14. *Amphiporus exilis*. Dorsal view of head to show arrangement of ocelli. $\times 8$.

well as in color and habits, this species, like the last, recalls *A. lactifloreus* (Johnston) McIntosh. Its anatomical structures are, however, very different, as will be seen from the following description.

Ocelli.—Exceedingly numerous and minute. They are arranged on the head in four elongated clusters (fig. 14). Two of these clusters lie on each antero-lateral margin of the head, while the two other groups lie more posteriorly (just in front of the brain), and extend from near the middle line obliquely outward and backward. Sometimes the two posterior clusters are united in front into a continuous V-shaped group. The number and distribution of these eyes is indicated by the following table, which shows the numbers found in ten individuals:

	No. of ocelli in anterior clusters.		No. in posterior clusters.	
	Right.	Left.	Right.	Left.
1.	12	11	15	17
2.	16	17	26	28
3.	18	19	33	30
4.	23	23	32	31
5.	25	24	40	42
6.	25	26	52	46
7.	28	26	45	46
8.	35	37	54	45
9.	35	35	51	53
10.	60	56	71	73

In the specimens examined, therefore, the number of ocelli in the front clusters varied from 11 to 60, that in the posterior clusters from 15 to 73. The average in the 10 individuals is about 28 in each anterior cluster, and 41 in each posterior group.

All the ocelli are minute, but nevertheless very irregular in size, some being several times as large as others. From the ventral surface the anterior marginal clusters only are seen.

Proboscis.—The proboscis sheath is long and slender. Even in this elongated species it reaches within a few millimeters of the posterior end of the body. The proboscis also is slender, though of moderately large size. It reaches well backward in the body. The armature of the proboscis is especially remarkable. The central stylet is moderately slender, rather small, and rests on a moderately heavy basis. The basis is somewhat conical in form, and rounded posteriorly (Pl. VII, fig. 5). In addition to the central stylet there are usually 8 pouches of accessory stylets (Pl. VII, fig. 5), though the number varies from 6 to 12. In each pouch are one or two slender stylets. Often there is a single fully developed stylet, and a second, immature stylet in most of the pouches. The proboscis is usually extruded when the animal is killed.

Cerebral sense organs.—Situated far in front of brain—nearly at end of snout when the head is contracted—and fairly well developed. Their canals open on antero-lateral borders of tip of snout.

The blood-vascular system resembles that in other species of the genus.

Nephridia.—The nephridial system shows peculiar deviations from the arrangement usually found in the Metanemerteans. A pair of main canals with numerous branches runs longitudinally above the lateral nerve cords, as in other species. These reach forward well toward the brain and extend posteriorly far into the intestinal region. Their branches ramify both above and below the lateral nerve cords. The number and position of the efferent ducts is remarkable—there are commonly 20 or more on each side. The first is near the anterior end of the main nephridial canal, and sometimes opens on the ventro-lateral aspect of the body, as in other species of the genus. Back of this, however, were counted nine other efferent ducts on each side in the esophageal region, and at least as many more were present on each side in the intestinal region. These ducts were mostly small and opened on the dorsal aspect of the body, as in many Heteronemerteans. The positions of the efferent ducts were sometimes immediately above the lateral nerves, and sometimes but a little laterally from the proboscis sheath. Most commonly, however, the ducts occupied positions between these two extremes, so that the majority of the nephridiopores were situated on the dorsal surface about half way between the lateral margin and the median line (Pl. XI, fig. 3). As noted on page 52, an approach to this condition is found in *A. leuciodus*. These appear to be the only species of the genus, and indeed the only Metanemerteans, in which the nephridiopores are situated on the dorsal surface of the body.

The *intestinal cæcum* is enormously developed. Its diverticula reach forward on each side even to the anterior end of the brain. In the brain region each of the cæcal diverticula appears as a rounded lobe on either side directly above, and closely approximating to, the dorsal brain-lobe. Back of the brain there are several rather slender lobes on each side. These lie mainly above the lateral nerves, but send off branches below the nerves at frequent intervals. Somewhat farther back in the esophageal region these lateral lobes join the main, unpaired cæcum, which lies immediately below the esophagus. This cæcum, throughout its course to the intestine proper, gives off numerous lateral diverticula on each side, and these branch upward above the lateral nerve cords (Pl. XI, fig. 3).

Sub-muscular glands.—These occur abundantly in the brain region, and are still more closely packed together in the anterior portion of the esophageal region. They occupy positions, as in other species, in the connective tissues beneath the musculature in the latero-ventral regions of the body. Each gland is composed of a number of cells, and each has a duct leading through the layers of the body wall to the exterior on the latero-ventral aspect. A much smaller number open on the dorsal surface. In the posterior end of the esophageal region these glands have almost entirely disappeared, although a few are met with in the anterior portion of the intestinal region.

Color.—The color of the individuals of this species is commonly a homogeneous, opaque white, very pale flesh color, or pale yellowish-white. This color is continuous throughout the length of the body, both above and below, except where the internal organs show through. The smaller specimens are pale, while the larger ones almost always exhibit a brownish color, which indicates the position of the intestine. Sometimes minute reddish-brown specks are distributed over the dorsal surface. Occasionally a worm of this species is met with in which the intestinal lobes are pale orange. The brain is plainly distinguishable in the living worm because of its pinkish coloration.

Habitat.—*Amphiporus exilis* is one of the most common, as well as the most widely distributed species of nemerteans met with on the expedition. It occurred abundantly at nearly all the collecting stations from Victoria, B. C., to Dutch Harbor, Unalaska. The worms are restless and are often seen crawling over stones between tides. They live among barnacles, mussels, etc., from low water well up to high water mark, and are found abundantly under stones in almost all sorts of locations. The species is especially hardy.

Tetrastemma Ehrenberg.

Symbolæ Physicæ, Berlin, 1831.

This genus includes a group of very small, slender worms, seldom more than 20 to 30 mm. long, with slightly flattened body, and usually with four well-developed ocelli, which form a quadrangle on the head. In a few species (cf. *T. aberrans*) these ocelli are each replaced by a group of two or three smaller ones, and in other species ocelli are wanting entirely. The anatomical structures are very similar to those of *Amphiporus*, and the distinctions between the two genera are not clearly defined. The mouth and proboscis open together. The cerebral sense organs lie close in front of the brain. The proboscis sheath extends to the posterior end of the body, and the proboscis is well developed, armed with central stylet and pouches with accessory stylets, and usually provided with ten nerves.

Only three species of the genus were met with on the expedition, although it seems probable that a number of other forms of these minute worms will be found later.

19. TETRASTEMMA BICOLOR sp. nov.

Pl. I, fig. 6.

Body moderately slender, rounded both above and below; much larger and longer than most species of the genus, sometimes becoming 50 to 60 mm. in length in extension.

Color.—This species is bright brownish-red or orange the whole length of the dorsal surface; the whole ventral surface is pale gray or whitish. The anterior border and lateral margins of the head, as well as the lateral margins of the body for a short distance back of the head, have the same whitish color as the ventral surface. A narrow, median, white stripe, sharply marked off from the reddish color of the dorsal surface, extends from the white, anterior border of the head nearly to the posterior end of the body. Posteriorly the stripe becomes more irregular and is usually lost near the posterior extremity.

Ocelli.—Four, rather large, rounded, arranged nearly in the form of a square.

Proboscis.—Proboscis sheath and proboscis as in typical species of the genus. Proboscis provided with a moderately heavy central stylet about .075 mm. in length. Basis of central stylet somewhat conical in shape, swollen behind, and about $1\frac{1}{2}$ times as long as the stylet itself. There are two pouches of accessory stylets, with usually three or four stylets in each pouch.

The blood is dark red, and the blood vessels may be traced in the living worm the whole length of the body.

Habitat.—The species was found only at Kadiak, where it was dredged in about three fathoms. It slightly resembles some varieties of *T. vermiculus* Quatrefages, but the longitudinal bands of dark pigment between the two ocelli of the same side are lacking, and the median white line is sharply demarkated, so that the two species are undoubtedly specifically distinct.

20. TETRASTEMMA ABERRANS sp. nov.

This is a minute Nemertean, the specimens found not exceeding 12 mm. in length in greatest extension. Body moderately slender, slightly flattened. A pair of slight vertical slits on sides of head.

Color.—Pale yellow throughout, both above and below.

Ocelli.—Of moderate size, or rather small, arranged in four groups which form a rectangle, as do the single eyes of typical species of the genus. Each of the four groups is composed of three to five ocelli of variable size. The two anterior groups lie well toward the tip of the snout, while the two posterior groups lie above or slightly in front of the brain (fig. 15). The appearance of the eyes is such as to give at once an impression that the multiple nature of each group has arisen from the fragmentation of single ocelli. This I consider to be the case. At least one other species of *Tetrastemma* (*T. cruciatum* Bürger) is known in which the four ocelli are double, and I have often noticed other species of the genus—notably the fresh water *T. rubrum* (Leidy)—which showed almost conclusively that one or more of the six or seven eyes present had been derived from a splitting of the primary ocelli. In one instance the fragmentation had been carried so far that no fewer than 20 to 30 pigment spots were present.



FIG. 15. *Tetrastemma aberrans*. Dorsal view of anterior portion of body, showing outline of brain and arrangement of the four groups of ocelli. $\times 25$.

Proboscis sheath and proboscis as in other species of the genus. Mouth and proboscis open together; proboscis sheath reaches the posterior end of the body. Proboscis provided with a rather slender central stylet and basis; the two accessory stylet pouches each with two or three stylets of typical form. The proboscis possesses twelve nerves, and in this respect again shows a departure from the typical *Tetrastemma*, where there are usually but ten proboscidial nerves.

Nephridia.—The nephridial canals are short, and reach forward to the brain. Anteriorly each nephridium lies above the lateral nerve, but farther back the branches ramify both above and below the nerve. Near the anterior end of each of the main canals a large efferent duct passes outside of the lateral nerve, and bends downward and outward to open to the exterior on the lateral margin of the body. In one instance a double efferent canal was observed.

The head is provided with large cephalic glands which open on the tip of the snout. The *cerebral sense organs* are large. They lie mainly in front of the brain, although their posterior ends extend backward beside and lateral to the brain lobes. Each connects with the exterior by a canal which runs anteriorly to open on the lateral margin of the head.

A broad *intestinal cæcum* reaches into the anterior fourth of the esophageal region. It lies below the esophagus, and sends off a few wide lobes on each side, but these reach dorsally only a little above the lateral nerve. The esophagus opens into the cæcum far behind the anterior sexual glands, and nearly as far back as the middle of the body. The reproductive pouches lie both above and below the intestine.

As will be seen from the above description, this species agrees closely with the typical species of *Tetrastemma* in size, general appearance, and in the details of the internal anatomy. It differs from known species of the genus only in the fragmented nature of its eyes and in the number of nerves in the proboscis. It seems extremely probable, however, that when more of the described species have been examined in this regard, some of them will be found to contain more or less than ten proboscidial nerves. The eyes certainly resemble those of *Tetrastemma* more closely than they do those of any described species of *Amphiporus*.

Habitat.—Found among hydroids in about four fathoms in Glacier Bay, and between tides at Orca, Prince William Sound. Not common.

21. TETRASTEMMA CÆCUM sp. nov.

A small species which I shall refer provisionally to this genus was found by Ritter in considerable numbers at Kadiak. The species is especially remarkable, and quite aberrant from most other species of *Tetrastemma*, both in lacking ocelli and in being hermaphroditic. The body is rounded and of almost even diameter throughout. The head has a pair of inconspicuous, oblique, lateral furrows.

Color.—The worms are very pale, whitish or pale yellowish in color, with dark intestinal lobes.

Size.—Very small, not usually more than 5 to 10 mm. long and 0.5 to 1 mm. in diameter when sexually mature.

Ocelli.—Wanting.

Proboscis.—The proboscis sheath reaches nearly to the end of the body. The proboscis is remarkable for its enormous size as compared with the size of the body—when everted its diameter is practically equal to that of the body itself, although it is then comparatively short. Its armature consists of a central stylet with rather slender basis, and of two pouches of accessory stylets. The basis of the central stylet is slightly swollen and somewhat sharply truncated posteriorly. Each pouch contains 2 or 3 long, slender and delicate accessory stylets.

In cross section of the proboscis the inner and outer circular muscular layers appear as usual. The intervening layer of longitudinal muscles, however, is divided into two secondary layers separated by a thick sheet of nerves and connective tissue. The nerves appear to be more or less confluent, and not separated into a definite number of longitudinal cords as in most other species of *Tetrastemma*. This appearance may be partially due, however, to the action of the formalin in which the worms were preserved.

Sense Organs.—The cerebral sense organs are very well developed, and unusually voluminous as compared with the other organs of the head. They lie in front of the brain, and extend posteriorly on the ventral side of the brain lobes as far as the ventral commissure. Each sense organ communicates with the exterior by a small canal passing obliquely forward to open on the lateral margin of the head.

The *brain* is of small diameter, but its extent antero-posteriorly is comparatively great.

Reproductive organs.—The individuals are hermaphroditic, and probably to some extent protandric although there is considerable variation in this respect. One of the individuals sectioned was filled with ripe spermaries only, but all the others possessed enormous ova, with the spermaries disposed irregularly. The mature ova were fully two-thirds the diameter of the body, and hence were arranged at irregular intervals in a single row. Where the ova were mature the spermaries were smaller and contained much fewer spermatozoa than in those individuals which were without large ova. Many of the spermaries had ducts which pierced the muscular layers to reach the dorso-lateral surfaces of the body. In some cases where these ducts were fully formed, and the spermatozoa therefore mature, the ova in the same individual were but half grown. The sexual products were mature in July.

Tæniosoma Stimpson.

Tæniosoma STIMPSON, Proc. Acad. Nat. Sci. Philadelphia, p. 162, 1857.

Polia DELLE CHIAJE, Mem. sulla storia e notomia degli anamali senza vertebre del regno di Napoli, Naples, 1823-28.

Eupolia HUBRECHT, Report of Challenger Exped. Zool., XIX, 1887.

Eupolia BÜRGER, Fauna u. Flora von Neapel, Monogr. 22, p. 598, 1895.

For the reasons given on page 4, it seems absolutely necessary to adopt for this genus the name given by Stimpson in 1857 rather than accept that of Hubrecht of 30 years later, even though most European writers have ignored Stimpson's brief, but careful, diagnoses.

The species belonging to this genus show a remarkable specific variation in the general shape and size of the body. Some are characterized by extremely long, slender, flattened, and much twisted bodies, while others are short, thick, and cylindrical. In all the species, however, the head in life is rounded in front and is sharply marked off from the parts immediately following by lateral constrictions. Horizontal furrows are wanting, but small, oblique or transverse grooves may be present on the head. In strong contraction the esophageal region becomes greatly swollen, the head is drawn in (pl. II, fig. 4), so that the anterior end of the body is large and shortly truncated.

Proboscis sheath and proboscis short, seldom reaching more than one-third the length of body. Proboscis opening subterminal, minute. Mouth a small round opening on the ventral surface immediately behind the ganglia.

Muscular layers of body composed of a thick outer longitudinal, a circular, and a less thickened inner longitudinal layer. Outside the muscular layers is a well developed cutis, composed of a thick inner layer of connective tissue, and an outer layer of glandular tissue. The external epithelium is thin, as compared with the other layers of the body, though the fibrous layer separating it from the cutis is well developed. The musculature of the proboscis consists of an inner longitudinal, and an outer circular muscular layer. Consequently there can be no muscular crosses.

The cephalic glands are enormously developed. They stretch backward on all sides beyond the brain, and even reach some distance into the esophageal region.

The lateral nerves lie immediately outside the circular muscular layer. There are three longitudinal blood vessels.

Ocelli are usually present in great numbers, though very small.

The worms are sluggish in their habits, are unable to swim, and usually show great irregularities in the diameter of the body. They

are prone to twist themselves in sharp coils, or in knots, and often lie in lumps. They are usually capable of contracting and extending their bodies to a remarkable degree.

22. *TÆNIOSOMA PRINCEPS* sp. nov.

Pl. II, figs. 3, 4.

Body of very large size, long, thick, largest in the esophageal region, cylindrical in anterior portion, flattened on ventral surface posteriorly; in contraction nearly cylindrical throughout. Head sharply marked off from body in extension, rounded in front, flattened dorso-ventrally; in contraction drawn almost entirely into the parts immediately following, so that the anterior portion of the body is greatly swollen and sharply truncated in front. In contraction the anterior end of the body is thrown into massive folds, and the whole body is remarkably short and thick (Pl. II, fig. 4). A pair of inconspicuous, oblique grooves lies on the antero-ventral surfaces of the head; into these the canals leading from the cerebral sense organs open. The esophageal region is scarcely more than one-twelfth the length of the body. In alcoholic specimens there is usually a median ridge on the dorsal surface running the length of the body, except in the head and esophageal regions.

Color.—The dorsal surface is deep ochre yellow, sometimes inclining to orange, and sometimes to brownish, and thickly strewn with minute irregular dark red spots. The reddish markings are most conspicuous near the anterior end of the body, and in the dorsal, median line. In many places a large number of the reddish dots become confluent, and form an irregular patch of deeper color. These patches commonly occur as broken longitudinal lines. Such lines are most abundant on the middle of the dorsal surface where they form a median longitudinal band of reddish-brown. The ventral surface is paler and the reddish markings are wanting. Along the median line the color is brighter yellow than elsewhere on the ventral surface. This is apparently due to the absence in this position of the opaque intestinal lobes. The ventral surface often exhibits a greenish tinge to the yellow ground color. The posterior extremity is pointed and much paler than the rest of the body.

Size.—*T. princeps* grows to a size greater than has previously been described for any species of the genus. The individuals found were from half a meter to two meters in length when extended; when contracted, but a small fraction of this length, and proportionately thick (Pl. II, fig. 4). After long standing in alcohol a section of the

body of one specimen still measured 15×18 mm. It is one of the largest Nemerteans of the coast.

Ocelli.—There are many minute ocelli arranged in an irregular group on each side of the tip of the head. The number of such ocelli is commonly 40 or more in each of the two groups.

The *mouth* is a small rounded pore, and is situated several millimeters back from the tip of the head in large individuals. The proboscis-pore is also minute, and is situated subterminally as usual.

Proboscis.—The proboscis sheath reaches some distance into the esophageal region, but is very short when compared with the length of the body. The proboscis is short and weak. Its muscular and epithelial layers are as in other species of the genus.

The *cephalic glands* are enormously developed. They occupy a large proportion of the area in the anterior portion of the head, surround the brain on all sides, and extend still further backwards into the anterior end of the esophageal region. Here they lie in the outer longitudinal muscular layer around the whole circumference of the body.

Body walls.—The outer longitudinal muscular layer about equals in thickness the other two muscular layers combined. In the intestinal region the inner longitudinal muscular layer becomes extremely thin on the lateral aspects of the body, and is much reduced dorsally. It is only on the ventral side that this layer retains its comparative thickness. The cutis is thinner than in most species of the genus, and especially is this true of its inner, fibrous layer. This layer is, throughout most of the body, reduced nearly to the condition of a thin membrane. It is commonly not much thicker than the muscular layer beneath the body epithelium. The epithelium itself is thin in comparison with the massive muscular layers of the body.

The *blood lacunæ* in the head lie directly above the brain, as in other species of the genus. They are, however, remarkably large, and are crossed in various directions by numerous bundles of muscular tissue, which tend to subdivide the lacunæ into numerous smaller spaces. The longitudinal blood vessels are as usual. The dorsal vessel passes out of the proboscis sheath early in its course.

Nephridia.—Situated in anterior and middle portions of esophageal region. Several efferent ducts on each side. These are small in diameter and pass above the nerve cords, opening on the lateral aspects of the body dorsal to the lateral margins.

Cerebral sense organs.—The dorsal lobes of the brain greatly exceed the ventral lobes in size, and lie somewhat lateral as well as above them. The cerebral sense organs are voluminous. They extend for-

ward on each side, external and ventral to the dorsal brain lobes, nearly as far as the ventral commissure. Here, at the anterior extremity of each sense organ, a canal passes obliquely downward and outward to open into a shallow oblique furrow on the ventro-lateral aspect of the head. The sense organs are closely united with the posterior ends of the dorsal brain lobes. In the middle region of the brain, the anterior ends of sense organs are triangular in section, and lie external and between the dorsal and ventral ganglia. Farther back a glandular appendage of the sense organ pushes itself in between the internal faces of the brain lobes. This appendage fuses with the ventral portion of the sense organ more posteriorly. The brain lies deeply buried in the tissues of the head and nearly in the median line, but the lateral nerves while still in the region of the cephalic sense organs bend sharply outward, and occupy throughout the remainder of their course positions immediately external to the circular muscular layer of the body wall.

The *genital products* were nearly mature in July. The oviducts were in many instances preformed, and opened on the dorso-lateral aspects of the body.

Habitat.—Only four individuals of this species came under my observation. One was collected at Cape Fox (Kincaid), two at Yakutat, and the fourth at Orca in Prince William Sound. All were found under stones in rather hard mud at low water. The individuals contract strongly when handled, throwing the surface of the body into wrinkles, and often coil the posterior portion of the body into a close spiral, much as does *Cephalothrix*.

Lineus Sowerby.

The British Miscellany, London, p. 15, 1806.

Representatives of this genus are characterized by a slender, sometimes thread-like body, usually rounded throughout. The body is commonly twisted and coiled into an irregular mass. The movements are sluggish. The animals creep over objects and readily move about on the surface of the water, but they are unable to swim. The body is extremely contractile; the head is often slightly wider than the body, of oval shape, and is usually provided with numerous minute ocelli, often arranged in a single row on each side of the head. A caudal papilla or cirrus, a diagonal muscular layer, and neurochord cells are all wanting. The proboscis sheath is often short in comparison with the length of the body.

23. *LINEUS VIRIDIS* (Fabr.) Johnston.

Planaria viridis O. FABRICIUS in O. F. Müller, Zool. Dan. Prod., 1776; Fauna Grœnlandica, p. 324, 1780.

Planaria gesserensis MÜLLER, Zool. Danica, II, p. 32, 1788.

Nemertes obscura DESOR, Boston Journ. Nat. Hist., VI, pp. 1 to 12, 1848.

Lineus viridis JOHNSTON, Catalogue British Non-parasitical Worms, pp. 27, 296, London, 1865.

As stated by Verrill,¹ there seems little doubt that the description of this species sent by Fabricius to Müller and published by him in the Zoologica Danica, is entitled to retain priority in nomenclature instead of Müller's *gesserensis* of later date, which has been adopted by most recent European writers.

Characteristic individuals of this species were found under stones at low water at New Metlakahtla, on Annette Island.

Body moderately slender, rounded throughout, but slightly flattened posteriorly; head slightly wider than the parts immediately following; cephalic slits long and deep, with pale margins above and below, reaching anteriorly close to the proboscis pore. The anterior end of the mouth does not reach quite so far forward as the posterior end of the cephalic slits. Length usually 100 to 200 mm.

On each side of the head in front of the brain and close to the lateral borders is a single row of minute ocelli (fig. 16). The number of these is commonly from four to six on each side, though some individuals have as many as eight, and very young specimens but a single pair.

Color.—The Alaska specimens were dusky or brownish green, becoming dark brown anteriorly, and commonly paler on the ventral surface, especially posteriorly. The head is very pale on lateral margins and in front. The brain is large, reddish, and shows distinctly through the pigment of the body. Cerebral sense organs paler but easily distinguished in life, with conspicuous canals leading to the posterior ends of the cephalic slits (fig. 16).

Habitat.—This species, besides being found in Alaska, is widely distributed in northern waters. On the east coast of America it occurs from Long Island Sound to Greenland. It is found on nearly all the coasts of northern Europe. It has also been found in the Medi-

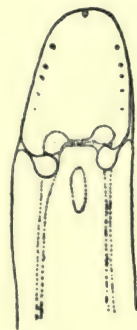


FIG. 16. Outline of anterior portion of body of *Lineus viridis* showing arrangement of the ocelli, and position of brain, cephalic sense organs and mouth. $\times 8$.

¹Trans. Connecticut Acad., VIII, p. 421, 1892.

terranean, though it is there comparatively rare and small. It is usually found between tides under stones in muddy localities.

24. *LINEUS TORQUATUS* sp. nov.

pl. v, figs. 8, 9.

Body rather thick and stout for the genus, somewhat flattened throughout, but especially posteriorly and on the ventral surface. Head short, pointed in front, somewhat narrowed behind, slightly flattened. A slight annular constriction commonly marks off the head region from that immediately following. Sometimes this constriction is very conspicuous, and the head much narrower behind. Esophagal region rounded above, flattened below. Intestinal region commonly well flattened but without narrow margins. Posterior end slender.

Cephalic furrows rather short. In alcohol or formalin they join the terminal proboscis pore in front, but in life they are separated from it.

Ocelli.—Absent, at least in mature individuals. Mouth a minute pore or a large slit, according to state of contraction; situated a little behind posterior end of cephalic furrows.

Color.—The color is usually dark, reddish-brown, chocolate, or purple above; paler and commonly more reddish beneath. The dorsal surface is often flecked with irregular minute, inconspicuous whitish specks. A narrow transverse white band passes across the dorsal surface at the posterior ends of the cephalic furrows. This characteristic marking reaches only to the lateral edges, and is not seen from the ventral surface. The cephalic furrows are sometimes, but not always, bordered above and below by a narrow band of white. Furthermore a minute white spot occupies the region of the proboscis pore. The white borders of the cephalic furrows commonly connect this white spot with the white transverse dorsal band on the posterior portion of the head. On the extreme tip of the snout—in the white area around the proboscis pore—a pair of small pigment spots is sometimes present, one on each side of the proboscis pore.

Size.—Length usually 200 to 400 mm. in extension, width about 5 mm.

Proboscis.—The proboscis is moderately slender and of medium size. It is without color. The inner longitudinal muscular layer is almost entirely wanting; the crosses between the circular layers are distinct, and the nervous plexus is exceptionally well developed. A single pair of large nerves enters the proboscis at its point of attachment at its anterior end. They originate from the ventral commissure of the brain near the ventral ganglia, enter the proboscis from the ven-

tral side, pass backward for some distance on the right and left sides respectively, and later spread out into a cylindrical plexus immediately internal to the muscular layer, and separated from the inner epithelium only by a few longitudinal muscular and connective tissue fibers.

Glands.—The cephalic glands are very well developed, and occupy a large portion of the region of the head in front of the brain, both above and below the rhynchodæum. They do not extend posteriorly quite so far as the brain.

Nerves.—The nervous system is far more easily made out than in any of the related species with which I am acquainted. The individual nerves are large and are sharply defined in all cases. The nerves extending from the brain toward the tip of the snout are numerous and are all of large size. The esophageal nerves are also surprisingly large and quite conspicuous. They have several transverse connecting branches after their origin from the ventral ganglia. The most posterior of these connecting branches occurs just in front of the mouth. In the mouth region they communicate in several instances with the lateral nerves by means of branches which pass through the nervous plexus outside the circular muscular layer. These branches from the lateral nerves follow the nervous plexus to the vicinity of the esophageal nerves, which they join by passing directly through the circular muscular layer. I do not know that such an anastomosis between the lateral nerve cords and the esophageal nerves has been previously noted in any species.

The median dorsal nerve, situated just outside the circular muscular layer, is unusually conspicuous, and throughout a considerable portion of the intestinal region is supplemented by a second median nerve lying directly beneath the first, but in the midst of the internal longitudinal muscular layer. Branches connect these two nerves at frequent intervals.

Cerebral sense organs.—Voluminous. The canals leading to the exterior open on the summit of a broad papilla situated at the posterior, widened end of each of the cephalic slits.

Nephridia.—The nephridial canals are of much greater diameter than I have observed in any other Nemertean. The canal on either side is, throughout a portion of its length, equal to the lateral nerve cord in cross section. The nephridia extend through the anterior half of the esophageal region. The main tubule has a few very large branches, and these lie in the walls of the blood spaces about the esophagus. Anteriorly the branches lie mainly dorsal to the lateral nerves, but towards the posterior ends of the nephridia the branches

ramify more towards the ventral side of the esophagus. There is a single pair of efferent ducts which are of enormous size as compared with those of other species. These ducts are situated at about two-thirds the distance towards the posterior ends of the nephridia, and open on the dorso-lateral aspects of the body as usual.

Habitat.—This species is common in mud and under stones in muddy localities at Orca and Virgin Bay in Prince William Sound, but was not met with elsewhere on the expedition. The individuals are hardy and of sluggish movements. They do not break up nor contract excessively when thrown into killing fluid, and the proboscis is not usually everted when the animal is killed. Some, especially the smaller ones, when preserved are nearly cylindrical, but most individuals are flattened ventrally. The color is fairly permanent in formalin, and even in alcohol for some months.

Micrura Ehrenberg.

Symbolæ Physicæ, Berlin, 1831.

This genus includes mostly moderately small, slender forms, generally less rounded posteriorly, and of rather more active habits than *Lineus*. Its most marked distinction from the latter genus is that the posterior extremity of the body is provided with a slender, usually colorless, muscular caudal cirrus. This is formed of a continuation of the muscular tissues and integument beyond the posterior end of the alimentary canal.

The species of *Micrura* are generally, though not always, more brightly colored and have more distinct markings than those of *Lineus*. The vast majority of the species are provided with numerous ocelli, though some are blind. The head is slender, and not distinctly separated from the rest of the body. The lateral faces of the body are not provided with thin edges as in *Cerebratulus*, the intestinal region is not so much flattened, neurochord cells are not present in those species which have been studied, and none of the species are able to swim as do all species of *Cerebratulus*. The mouth is usually smaller than in *Cerebratulus*, and the intestinal lobes are not so deep.

The proboscis is usually slender and comparatively weak; the proboscis sheath is sometimes considerably shorter than the body.

25. *MICRURA VERRILLI* sp. nov.

Pl. v, figs. 1, 2, 3.

Body moderately elongated, widest anteriorly, tapering to an acute anterior extremity; much more slender posteriorly. Ventral surface

flattened; dorsal surface rounded. Head narrow in front. Cephalic furrows long and deep; at their posterior ends each is met by an oblique, shallow depression above and below. Proboscis-pore exactly terminal; anterior ends of cephalic furrows well separated from proboscis pore. Mouth small, situated as far back as posterior ends of cephalic furrows. Caudal cirrus small, slender, easily broken off.

Color.—This is one of the handsomest and most striking of all the described species of Nemerteans. The color of the dorsal surface is deep purple or wine-color; that of the ventral surface is purest white.

On the dorsal surface are usually 15 to 40 very sharp, pure white, transverse bands or lines connecting with the white color of the ventral surface. These transverse bands are nearly as narrow as pencil marks, and are situated at fairly regular intervals throughout the length of the body. They are sometimes more or less interrupted, but always sharp and distinct. On the dorsal surface of the tip of the snout is a small triangular marking, always very conspicuous because of its bright orange color. Following behind this is a narrow transverse white band, followed by broad purple and narrow white bands in succession. The cephalic furrows lie within the white color of the ventral surface, and are bordered above with a very narrow margin of white. They reach posteriorly as far as the second white band.

After preservation in formalin or alcohol the worms are strongly rounded below as well as above, and the color of the dorsal surface changes from purple to red, while the orange spot on the tip of the snout disappears.

Ocelli.—None were found.

Proboscis.—Colorless, and shorter than in many species of the genus. Its microscopic structure shows distinctly the three muscular layers and the muscular crosses characteristic of the family. The inner circular muscular layer is very thin. The nervous plexus inside the circular layer is usually well developed.

Nervous system.—The dorsal ganglion of the brain is divided posteriorly into two distinct lobes, of which the smaller, dorsal lobe ends shortly, while the larger, ventral lobe continues into the cerebral sense organ. Each of these sense organs is of about the same size as one of the ventral ganglia, but considerably smaller than either dorsal ganglion. The duct lying on the external border of each of the pair of cerebral sense organs communicates, as usual, with the enlarged posterior end of the cephalic furrow by means of a wide duct opening directly outwards. The dorsal median nerve, lying just outside the circular muscular layer, is remarkably conspicuous throughout the whole length of the body.

A section through the esophageal region shows that the outer longitudinal muscular layer of the body wall is particularly thick, and that the esophagus is unusually small. The other layers are as in most species of the genus.

The lateral blood lacunæ break up in the esophageal region into numerous thin-walled vessels, or spaces, which surround the lateral and ventral walls of the esophagus.

Nephridia.—The nephridia extend through the anterior $\frac{2}{3}$ of the esophageal region, as a single profusely branched tubule on each side. All the branches of the main canal are small, and lie in close connection with the walls of the blood spaces about the esophagus. The efferent ducts are very numerous, but minute. They open on the dorso-lateral aspects of the body, usually not far above the lateral margins. In a single instance one of the efferent ducts was found to open beneath the lateral margin, but this must be looked upon as abnormal. In several instances two efferent ducts lay close together on the same side, but in such cases one originated much nearer the ventral side of the esophagus than did the other. The actual number of efferent ducts counted in one medium-sized individual was 17 on one side, and 24 on the other.

Reproductive organs.—The pouches containing the sexual products when mature become so voluminous as to occupy more than half the entire space within the body walls. In July, when the genital products are fully ripe, the ducts leading to the exterior are completely formed some little time before the elements are discharged. Each pouch has a single duct opening into a funnel-shaped depression through the epithelium on the dorso-lateral aspect of the body. The opening into the cavity of the ovary is on the surface of a broad papilla formed of long columnar cells, a portion of which bend inward to guard the opening. The ducts often have a somewhat tortuous course, and are likely to broaden out considerably in passing through the circular muscular layer.

Size.—The length of the largest individual observed was about 300 mm., and its width 6 mm.

The species is named in honor of Prof. A. E. Verrill, of Yale University, who, more than any one else, has helped to bring the American species of Nemerteans into orderly arrangement.

Stimpson¹ briefly describes from Bering Strait a species of *Cerebratulus* (*C. impressus* = *Micrura impressa*) which bears a superficial resemblance to the above. Stimpson's species, however, was flattened,

¹Proc. Philadelphia Acad. Nat. Sci., p. 160, 1857.

of a dusky gray color above, with narrow, colorless, transverse lines, and with a flesh-colored subtruncate head, much narrower than the body. The same author describes a somewhat similar species (*C. bellus* = *Micrura bella*) from Yezo Island, Japan. This had 10 bluish-white, narrow transverse lines across the ashy-gray dorsal surface, and a white ventral surface. The head was short, and of a vermilion color. Both these species should be referred to the genus *Micrura* as here defined.

Habitat.—This species was found only at Virgin Bay, in Prince William Sound. Here it was not uncommon under stones at low water, and was frequently met with in the parchment like tubes of *Carinella capistrata*, with which it was associated.

26. MICRURA ALASKENSIS sp. nov.

Pl. IV, fig. 2; Pl. XIII, fig. 1.

Body long and slender, rounded in esophageal region, flattened throughout the whole intestinal region. Head remarkably slender, elongated, and sharply pointed; cephalic furrows correspondingly long, but their anterior ends do not reach the proboscis pore. Mouth small, and well back from tip of snout; its anterior end reaches about as far forward as posterior ends of cephalic furrows.

No ocelli are present. The brain is reddish in color, and shows conspicuously through the tissues external to it.

The esophageal region is well rounded, and narrower than the succeeding portion of the body. The intestinal region is much flattened both above and below; its lateral margins are rounded, however. After preservation in alcohol the intestinal region is flattened or even hollowed ventrally, while the dorsal surface is very convex. Posteriorly the body tapers gradually, and at its pointed extremity an unusually long caudal cirrus is present. This is quite colorless, and contracts after preservation to but a fraction of its original size and length.

Color.—Two color varieties were met with. Most commonly the general color was a salmon or flesh-color. The esophageal region was pale salmon with tinges of brighter red, becoming lighter anteriorly; the head pale or nearly colorless; the brain region distinctly red; the intestinal region pale salmon, with much more deeply colored intestinal lobes. Running the whole length of the ventral side of the body—from near the mouth to the caudal cirrus—is a characteristic, narrow, cream or flesh-colored stripe in the median line. This stripe is conspicuous only in the intestinal region, though it may be traced forward to the mouth, as stated. In alcoholic specimens it can still be detected

in the intestinal region, though the natural color of the body has mostly disappeared. A similar, though much less conspicuously marked, median stripe occurs on the dorsal surface.

The second color variety had chestnut brown intestinal lobes, brownish esophageal region, slightly paler below; snout and margins of head colorless; brain red. The paler, ventral, median stripe was even more conspicuous than in the other variety.

Serial sections show that, while the cephalic furrows are unusually long, yet they are not really as deep as in many related species. The brain is very large; the posterior end of each dorsal ganglion is bilobed, the dorsal lobe ending freely, while the ventral lobe continues directly into the cerebral sense organ. The canals from the sense organs open into the very posterior ends of the cephalic furrows. The buccal, or esophageal, nerves are larger than in most species.

Accessory buccal glands.—On each side of the mouth, and extending a short distance into the esophageal region, is a series of peculiar glands—accessory buccal glands, they may be called. These glands are similar in their nature to, and apparently supplement, the ordinary buccal glands which line the mouth cavity. In the present instance, however, these accessory glands lie imbedded in the outer longitudinal muscular layer ventral to the lateral nerves. Here they greatly encroach upon the domain of the muscles, and occupy a large portion of the space between the circular muscular layer and the cutis (Pl. XIII, fig. 1). The gland cells are large, and are distended with a clear, granular secretion. These accessory glands appear to have originated from ordinary buccal glands which have passed outward and taken up a position outside the two inner muscular layers (Pl. XIII, fig. 1). They are arranged in clusters, and discharge their contents by irregular ducts leading through the two inner muscular layers to the epithelium of the buccal cavity and adjacent esophageal wall. A short distance back of the mouth the two lateral series of these accessory buccal glands unite beneath the esophagus, and are not found further posteriorly. The ordinary buccal glands are present as in related species.

Alimentary canal.—The *esophagus* is large in comparison with the thickness of the body wall. The histological difference between the epithelium lining its anterior portion and that of its posterior half is much more marked than in most related species. The delicate layer of circular and longitudinal muscular fibers which surrounds the epithelial lining of the esophagus in most of the *Heteronemertean*s becomes remarkably developed in this species. At the very posterior end of the esophagus—just anterior to the first intestinal pouches—

the circular muscles of the esophagus increase so greatly in number that they form a most conspicuous layer. In the region of its maximum development this layer becomes nearly half as thick as the circular layer of the body walls in the same section. In no other species of the *Lineidae* has this muscle been found of even approximately this thickness. Its fibers connect in part with the circular layer of the body walls, and to a lesser degree with the circular muscles of the proboscis sheath. But few fibers lie on the dorsal wall of the esophagus, so that this organ is largely bound up with the proboscis sheath in a continuous layer of muscles, and one cannot fail to see the striking resemblance between this circular layer and the inner circular muscles that are so highly developed in precisely the same region in *Carinoma* (p. 22).

Body walls.—The external longitudinal muscular layer of the body walls is especially weak when compared with the same layer in related species. This is partly shown by the fact that the cutis glands extend $\frac{3}{4}$ or more of the distance from the exterior to the circular muscular layer. Nearer the intestinal region the muscular layers are thicker, and the esophagus occupies correspondingly less space.

The three longitudinal blood vessels are very conspicuous throughout their length. The dorsal vessel leaves the proboscis sheath near the posterior ends of the nephridia, or at about $\frac{2}{3}$ the distance towards the posterior end of the esophageal region.

Nephridia.—The nephridial system consists of a pair of unusually large, longitudinal canals, which lie in the dorsal walls of the lateral blood lacunæ beside the esophagus. The nephridial canals send off very few branches, except near their anterior ends, where they divide into smaller branches. The main canals extend through about the middle third of the esophageal region. Each of the pair of longitudinal canals terminates posteriorly in a single, remarkably large efferent duct which opens on the dorso-lateral aspect of the body. The ducts sometimes lie exactly opposite, but in other specimens one lies some distance farther back than the other. In such cases, of course, one of the nephridia extends a corresponding distance farther posteriorly than the other. Each of the efferent ducts spreads out as it passes through the circular muscular layer into a broad sieve-like or filter-like structure with scores of small, nucleated cells. From this point a straight and comparatively narrow duct leads directly to the surface.

Reproductive glands.—The sexual elements are fully mature in the month of June, and the genital ducts at this time are fully formed. In the females each duct communicates directly with the cavity of the ovary by a funnel-shaped opening, and a similar funnel-shaped open-

ing lies at the outer end of the oviduct on the dorso-lateral aspect of the body. The bodies of many of these worms were so distended with sexual products that they were very easily ruptured and could consequently be preserved intact only with great care.

Size.—The length of this species is commonly about 150 mm. in extension, although several individuals were found which were more than 300 mm. long.

Habitat.—The species was found under stones between tides in rather muddy localities at New Metlakatla on Annette Island, at Glacier Bay, Sitka, Yakutat, and at Orca and Virgin Bay in Prince William Sound. At the four last-named localities the worms were abundant. Nearly 50 individuals, some of them nearly 300 mm. long, were found at Sitka massed together in a single cavity in coarse gravel mixed with mud. All were filled with fully mature sexual products, and the bodies of nearly all were in contact in a tangled mass.

Cerebratulus Renier.

Prospetto della Classe dei Vermi (t. Bürger), 1804.

The species of this genus are distinguished by long, flattened bodies, the lateral margins of which are thin, adapted for swimming. Most species are very active, swim readily with undulatory motion, can roll up spirally and become twisted, but are only moderately contractile in length, and do not draw together into a tangled mass. The dorso-ventral musculature is highly developed, as are likewise the longitudinal and oblique muscles.

Head usually pointed anteriorly, but very changeable in shape; lateral slits long and deep; proboscis pore terminal; mouth large, and situated behind the ganglia; esophageal region mostly rounded; intestinal region broad and flat with thin lateral margins; the posterior end extremely flattened and provided with a delicate caudal cirrus, which extends beyond the opening of the intestine, and in most species is easily broken off and lost. Eyes usually wanting; body commonly of a nearly homogeneous color without distinct markings (such as longitudinal and circular bands and rings).

Proboscis sheath reaches to posterior end of body; proboscis very long and strong. Intestinal pouches deep and mostly forked peripherally; central intestinal canal narrow. Neurochord cells probably commonly present in brain and lateral nerve cords, though they have as yet been found in but few species.

27. *CEREBRATULUS HERCULEUS* sp. nov.

Pl. I, fig. 5.

Body very large, stout, thick, broad, attaining a length of 2 meters or more, and a breadth of more than 25 mm.; remarkably broad when contracted, the body somewhat resembling that of a leech. One specimen, preserved in alcohol and strongly contracted, now measures 300 mm. in length, 25 mm. in width in intestinal region; 18 mm. in width and 15 mm. in thickness in esophageal region. The length of the esophageal region in this specimen is only about 55 mm. after preservation.

Head very short, thick, and bluntly pointed. Cephalic slits short, separated in front, reaching back in the alcoholic specimen but 7 mm. Mouth large, situated as far back as the posterior end of the cephalic furrows.

Esophageal region short and thick; intestinal region very broad and flat, with thin, wavy margins in life. Posterior extremity provided with a pale caudal cirrus of comparatively small size. Proboscis large, colorless, fully equal in size to that of a large specimen of *C. marginatus*. No ocelli.

Color.—Color very dark brown or reddish brown throughout the whole dorsal surface, rather paler and less bright ventrally.

This gigantic Nemertean is not clumsy in its movements, but is active, and swims rapidly and gracefully. It was met with only at Sitka, where it occurred in considerable numbers in mud at low water mark, associated with *C. marginatus*. The worms are fragile, and break spontaneously unless carefully handled.

28. *CEREBRATULUS MARGINATUS* Renier.

Cerebratulus marginatus RENIER, Prospetto della Classe dei Vermi (t. Bürger), 1804.

C. angulatus MCINTOSH, British Annelids; Pt. I, Nemerteans, p. 195, Ray Society, 1872-73.

C. fuscus VERRILL, Trans. Connecticut Acad., VIII, p. 438, 1892.

This large and active Nemertean was found in several localities about Sitka, but not in great numbers. The individuals there found possess the typical color of the species, with which they agree externally in every detail except the shape of the body. All the Alaska specimens are much shorter and comparatively broader than those I have seen in Naples, although careful study of microscopic sections revealed no essential anatomical differences. It is therefore probable that this is but a local peculiarity of a single widely distributed species.

The worms were found near low water mark living in soft black mud beneath a considerable growth of 'eel grass.' The mud contained a great quantity of decomposed vegetable matter, and was saturated with sulphuretted hydrogen. The worms are excellent swimmers, and are very rapid in their movements in their underground burrows.

The specimens obtained measured up to 500 mm. or more in length, and about 15 mm. in width.

The color above was slaty-brown, dark gray, or greenish-gray, with white or colorless margins.

The species has been previously recorded from the Mediterranean, the coasts of Great Britain, Madeira, the northeastern coast of America, Greenland, and from other localities.

29. CEREBRATULUS OCCIDENTALIS sp. nov.

pl. vi, fig. 3.

Body 300 mm. or more in length in moderate extension; rather slender, rounded in front, flattened behind, and with very thin margins in the intestinal region, as in other species of the genus. Head changeable in shape, either rounded or acutely pointed, according to state of contraction. Cephalic furrows rather short.

Color.—Individuals vary considerably in the general color of body, but are most commonly chestnut brown or dull reddish anteriorly, and light chocolate brown in the intestinal region. The ventral surface is brownish flesh-colored, with a median, ochre ventral stripe. Sometimes the ventral surface is nearly chocolate throughout its entire length. A darker median dorsal stripe is indicated.

Proboscis.—Remarkably small and slender, being many times smaller than in most related species of equal size. It is colorless, and is usually everted when the animal is killed.

In internal anatomy but few points need special mention. The cephalic glands are unusually well developed, and continue backward as the cutis glands. The brain is remarkably voluminous, the dorsal ganglion bilobed, the lower lobe continuing into the cerebral sense organ.

The mouth is very large, and is provided with an unusual abundance of buccal glands. There are many diagonal fibers between the proboscis sheath and the body musculature.

Nephridia.—The nephridia are of moderate length, and occupy the middle third of the esophagal region. The main tubules lie in the angles between the esophagus and the proboscis sheath. They are profusely branched towards their anterior ends, each branch lying in

the wall of one of the esophageal blood lacunæ. Farther back the branches unite into a single tubule on each side. Their main canal continues backward for a considerable distance in the wall of a lateral blood lacuna, and is without branches. At its posterior extremity the efferent duct bends to the dorso-lateral surface of the body, as usual.

The sexual products are fully mature in July.

Habitat.—This is a very active species. It was found in abundance at Wrangell, Yakutat, Orca, and Virgin Bay. It inhabits the shore at half tide and below, in muddy places and under stones. The small size of the proboscis will distinguish it from related species.

30. CEREBRATULUS LONGICEPS sp. nov.

Pl. v, figs. 4, 5, 6, 7.

Body much flattened throughout its whole length; anterior portion remarkably narrow and slender, becoming wider posteriorly. Head much narrower, more slender, and longer than in most species of the genus, acutely pointed in front, much flattened dorso-ventrally, and with the tip of the snout often slightly curved upward. A section through the head is often concave both above and below, showing that the head is thicker laterally than in the median line. The head is directly continuous with succeeding portions of the body. Frontal sense organs very highly developed.

Cephalic furrows very long, and remarkably deep and wide. Anteriorly they do not reach quite to tip of snout. They are, consequently, well separated from the proboscis pore, which is situated subterminally. The mouth is situated as far back as the posterior end of the cephalic furrows.

From the narrow, pointed head the esophageal region gradually widens as it passes backward, but it remains unusually flat throughout; the intestinal region is not sharply marked off from the esophageal region, but widens gradually toward the posterior third of the body, and narrows toward the posterior extremity. The intestinal region is even flatter than the more anterior portion of the body. The caudal cirrus was not observed.

Proboscis.—The proboscis sheath is reduced to a frail tubule in the posterior third of the intestinal region. The proboscis is slender and colorless; it has the three muscular layers and the muscular crosses, as usual in the genus.

Color.—Dorsal surface dark brownish-black or purplish, much paler on tip of snout, and on borders of cephalic furrows. This paler border is wider on the ventral than on the dorsal borders of the furrows. It

is sometimes so much increased that it covers the whole ventral surface in the region of the mouth, and gradually becomes darker toward the tip of the snout, as well as posteriorly. The color of the ventral surface is similar to that of the dorsal surface, but is commonly slightly paler, especially anteriorly, and has a grayish tinge.

No eyes were found.

Size.—Length of largest specimens collected about 300 mm.; width in intestinal region 6 mm.

The body is fragile, and the specimens are often broken in killing. After preservation in formalin or alcohol the body tapers gradually toward the narrow head, is widest in the posterior third or near the posterior end, and greatly flattened throughout. The head retains its long, pointed appearance, the tip is recurved, and the cephalic furrows in most specimens are deep and widely open.

Frontal sense organs.—On the exact tip of the head are three rather deep and wide pits, easily overlooked in the entire animal, but very conspicuous in sections. These are undoubtedly sensory in their nature, and are lined with slender rod-like cells with especially large cilia. Bürger has described in detail such sense organs in *Micrura* and *Cerebratulus*, and somewhat similar ones in other genera. These 'frontal organs,' as they are called, lie above the proboscis pore; one of them is situated in the median line and the other two are placed symmetrically on the antero-lateral margins.

The *brain* is remarkably large, and the dorsal ganglia are much larger than the ventral. The posterior ends of the long lateral furrows are greatly expanded.

Cerebral sense organs.—These also are very voluminous and are continuous with the posterior ends of the dorsal ganglia. The canals leading to the exterior are large, and open into the posterior ends of the cephalic furrows. Internally each canal passes directly beneath the dorsal ganglion to its internal ventral border, and then bends dorso-laterally to the external border of the sense organ. These canals leave the cephalic furrows far back of the cerebral commissure, and at about the point where the ventral ganglia merge into the lateral cords.

Nephridia.—The nephridial system presents remarkable deviations from the type usually found in the genus. The nephridial canals extend throughout the whole length of the esophageal region, and communicate with the exterior by upwards of *sixty* efferent ducts on each side. In the region of the mouth, or directly behind it, are one or two nephridial tubules on each side, quite independent of the rest of the system. Each of these tubules consists of a coil of fine canals lying

on the dorsal side of the lateral blood lacunæ, and projecting freely into the cavity of the lacuna. From each coiled tubule an efferent duct leads directly to the dorsal surface of the body. Back of these anterior, isolated nephridia a continuous richly branched and much coiled canal extends posteriorly on each side as far as the end of the esophageal region. The branches of these canals are limited to the dorsal and lateral surfaces of the lateral blood spaces, which occupy the angles between the esophagus and the proboscis sheath. The coiled tubules project freely into the blood spaces, and encroach considerably upon their area. The very numerous efferent ducts, which are given off from these tubules, pass directly outwards to the surface of the body. Those which pass out from the most lateral of the nephridial tubules, open on the dorsal surface near the lateral margins of the body, while those which leave the tubules nearest to the proboscis sheath open on the dorsal surface not far from the median line. The greater portion of the nephridiopores, however, lie rather nearer to the lateral margins than to the median dorsal line. Although there are practically the same number of efferent ducts on each side, this does not signify that these ducts are paired, but rather that the average number on each side is identical. In several instances an unusually large efferent duct on one side was accompanied by one of similar size nearly opposite. These ducts vary greatly in size, some being several times as large as others. Great irregularity likewise exists as to their distribution along the course of the nephridial canal. In the anterior third of the esophageal region they are well separated, but more posteriorly, portions of two or three sometimes appear on the same side in a single section.

Sexual glands.—The reproductive glands appear immediately behind the nephridia, and in both sexes alternate with the intestinal pouches. The sexual products were fully mature in July, and in both sexes the genital ducts were fully formed. They were lined with a special flattened epithelium, and opened on the dorso-lateral aspects of the body in both sexes. The ova when immature are attached by a narrow stalk to the wall of the ovary, and later break off and fall into the ovarian cavity. The spermatozoa have short, oval heads instead of the slender, pointed ones so common in the genus.

Habitat.—Yakutat; under stones at low water; not common.

31. CEREBRATULUS MONTGOMERYI sp. nov.

pl. VI, figs. 1 and 2.

Body large, very long and ribbon-like when fully grown, and much flattened, except in esophageal region. Head variable in shape, according to state of contraction; sometimes rounded and obtuse, at other times much elongated, pear-shaped, and flattened dorso-ventrally. The anterior portion of the body, back as far as the intestinal region, is narrower and thicker than the posterior portions, and has rounded margins; in the intestinal region the body is very flat, and the lateral margins are extended to very thin edges. In partial contraction the dorso-ventral muscles, situated a little distance from the outer edge of the margins, contract so strongly as to produce a lateral ridge on each side both above and below the lateral edge. A transverse section consequently shows that the lateral margin is thicker distally than it is nearer the median line. These lateral ridges are often seen in specimens preserved in alcohol or formalin. Posteriorly the body becomes still thinner, and is narrower toward the extremity. The posterior end is either obtuse or sharply pointed, according to the state of contraction. The posterior opening of the intestine is subterminal. In none of the many specimens obtained was the caudal cirrus present, though such an appendage is probably present in uninjured worms.

The cephalic slits are moderately elongated, and extend backward as far as the anterior end of the mouth. Their posterior ends are wide and deep, and in life their margins are thin and widely separated. Anteriorly they do not reach quite to the proboscis pore, except when the animal is strongly contracted.

Color.—In life the whole body, both above and below, except the tip of the head, is bright blood red. The anterior extremity is tipped with a narrow band of white or yellowish-white. This white tip extends both above and below, and is not usually more than a few millimeters wide. The proboscis is light red in color.

Size.—Individuals were most commonly from one to two meters in length, and 8 to 10 mm. in width in the intestinal region. A few of the specimens obtained measured as much as two and a half meters when extended.

The individuals are generally hardy, and are not so prone to break spontaneously into fragments as are those of many other species of the genus. They contract much less violently than most other Nemerteans when killed, and may consequently be easily preserved entire by killing in a dilute solution of formalin in sea water.

Proboscis.—The proboscis is pale red, and of moderate size for the genus. Its musculature consists of an inner circular, a longitudinal, and a very thin outer circular muscular layer. It is, therefore, different from those of nearly all the species of the family *Lineidæ*, in that the inner longitudinal muscular layer is wanting. There are fibers passing between the inner circular layer and the thin outer circular layer, but these fibers do not form such distinct crosses as are characteristic of most of the members of the family. The internal epithelium is thick and highly glandular. The nerve plexus beneath this layer is unusually conspicuous, and lies directly internal to the circular muscular layer. The proboscis is very often retained in place after the animal has been killed. The muscular layers of the proboscis sheath are rather thick, and the circular muscular fibers often cross into the circular muscles of the body in the median line.

In the anterior portion of the head a rich growth of glands penetrates the other tissue nearly to the central proboscis sheath. These glands mostly open directly outward on the whole circumference of the head, although a few open on the tip of the snout. Back of the lateral slits the glands are restricted to the cutis. In the region of the mouth the cutis glands are separated from the outer epithelium by a layer of interlaced fibers of connective tissue, forming a basement layer of double the thickness of the epithelium. In the intestinal region the cutis glands are much reduced, and scattered. The outer muscular layer of the body is about as thick as the two inner muscular layers combined.

The mouth is much elongated, and its anterior end reaches forward as far as the posterior ends of the cephalic slits. The intestinal pouches are deep and narrow, and are forked distally.

Nephridia.—The nephridial canals are profusely branched, and lie in contact with the blood spaces around the esophagus in front of the middle esophageal region. Their extent longitudinally, however, is short. The main nephridial canals lie in the angles between the esophagus and the proboscis. Near their posterior extremities a large efferent duct passes obliquely upward on each side and opens on the latero-dorsal aspect of the body. As described by Bürger¹ in *C. marginatus*, one of the efferent ducts often lies far behind the other. Posterior to the efferent ducts the nephridial canals are smaller, and their branches end a short distance farther back. The blood lacunæ in the head in the specimens sectioned were very much reduced in size.

¹ Fauna u. Flora Neapel, Monogr. 22, p. 622.

The brain lobes are large, and the ventral commissure enormously thick. The well developed cerebral sense organs abut closely against the posterior ends of the dorsal ganglia. Their ciliated canals pass obliquely inward from the posterior ends of the cephalic slits. In their course these canals pass external and ventral to the dorsal ganglia. The median dorsal nerve, lying just outside the circular muscular layer of the body, is large and conspicuous throughout nearly the whole length of the animal.

Ocelli are wanting in the adult worm.

In specimens collected in June and July the genital products had evidently been recently discharged.

This species is named in honor of Dr. T. H. Montgomery, Jr., of the University of Pennsylvania, whose studies on the Nemerteans form most valuable contributions to the knowledge of the group.

Habitat.—This magnificent Nemertean was found abundantly under stones in muddy places near low water mark at most of the collecting stations between Sitka and Unalaska. At Orca and Virgin Bay, in Prince William Sound, and at Dutch Harbor, Unalaska, it proved to be one of the commonest species. Professor Kincaid has sent me a large specimen from Puget Sound, in the State of Washington, where it is said to be not uncommon. This would indicate that the species may be found locally along the whole northwestern coast of North America south of Bering Sea.

32. CEREBRATULUS ALBIFRONS sp. nov.

Pl. IV, figs. 3, 4.

Body elongated, ribbon-like, flattened behind, rounded in front as in typical species of the genus. Margins of intestinal region pale and thin. Cephalic slits unusually long and deep, reaching well beyond posterior end of mouth.

Color.—General color of body brownish purple. Anterior end of head white, including both dorsal and ventral surfaces, and extending backward about as far as anterior end of mouth, and sometimes reaching along borders of cephalic slits to their ends. The esophageal region is dark smoky purple on dorsal surface; the ventral surface is similar but paler; the intestinal region inclines more to reddish. A darker line runs along the middle of the dorsal surface and the intestinal lobes appear more opaque.

Habitat.—Only a single specimen of this pretty species was secured, and this, unfortunately, had its posterior extremity missing. The specimen was about 150 mm. in length and of moderate propor-

tions. It was restless in confinement, and an active swimmer. It was found under a stone near low water mark at Hot Springs, near Sitka.

EXPLANATION OF PLATES.

The colored plates (I to VI) are reduced from colored sketches made, with a few exceptions, from the living animal. They were completed after the return of the expedition and have been retouched, and in some instances entirely redrawn, by Mr. A. H. Verrill. Every effort has been made to make the colors and the form of the body as natural as possible.

In the figures on the plates the following reference letters are used :

<i>ap</i> , attachment of proboscis.	<i>ijl</i> , inner fibrous layer.
<i>bg</i> , buccal glands.	<i>ilm</i> , inner longitudinal muscles.
<i>bg'</i> , accessory buccal glands.	<i>in</i> , intestine.
<i>bl</i> , blood lacuna.	<i>lm</i> , longitudinal muscles.
<i>ble</i> , epithelium of same.	<i>ln</i> , lateral nerve-cord.
<i>bm</i> , basement layer.	<i>m</i> , mouth.
<i>br</i> , brain.	<i>nep</i> , epithelium of same.
<i>bv</i> , blood vessel.	<i>nc</i> , nerve commissure.
<i>bva</i> , anastomosis of lateral vessels.	<i>nd</i> , efferent nephridial duct.
<i>cc</i> , ciliated canal of cerebral sense organ.	<i>nep</i> , nephridial canal.
<i>cgl</i> , cephalic glands.	<i>np</i> , nerve plexus.
<i>cm</i> , circular muscular layer.	<i>nv</i> , nerve.
<i>cso</i> , cerebral sense organ.	<i>oc</i> , ocellus.
<i>ct</i> , connective tissue.	<i>ocm</i> , outer circular muscles.
<i>cugl</i> , cutis glands.	<i>oep</i> , outer epithelium of proboscis.
<i>dc</i> , dorsal commissure of brain.	<i>olm</i> , outer longitudinal muscles.
<i>dg</i> , dorsal ganglion.	<i>ov</i> , ova.
<i>dgl</i> , secretion of cephalic glands.	<i>pcm</i> , circular muscles of proboscis.
<i>dn</i> , median dorsal nerve.	<i>plm</i> , longitudinal muscles of proboscis.
<i>e</i> , esophagus.	<i>pn</i> , proboscis nerve.
<i>eep</i> , epithelium of same.	<i>ps</i> , proboscis.
<i>f</i> , fibrous layer of cutis.	<i>psh</i> , proboscis sheath or its cavity.
<i>gc</i> , glandular cells of cerebral sense organ.	<i>rh</i> , rhynchodæum.
<i>gl</i> , integumental glands.	<i>ro</i> , opening of same.
<i>gp</i> , genital pouch.	<i>smg</i> , submuscular glands.
<i>i</i> , integument.	<i>sn</i> , nerve to cerebral sense organ.
<i>ic</i> , intestinal cæcum.	<i>sop</i> , opening of ciliated canal of sense organ.
<i>icm</i> , inner circular muscular layer.	<i>vc</i> , ventral commissure of brain.
	<i>vg</i> , ventral ganglion.

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PLATE I.

- FIG. 1. *Carinella capistrata* sp. nov. A large individual, about natural size. Virgin Bay, Prince William Sound.
2. *Carinella dinema* sp. nov. Victoria, B. C. Enlarged $2\frac{1}{2}$ times.
3. Head of same species. Side view. Enlarged 4 times.
4. *Amphiporus bimaculatus* sp. nov. Dorsal view of head. Glacier Bay. Enlarged 12 times.
5. *Cerebratulus herculeus* sp. nov. A large individual. Sitka. Half natural size.
6. *Tetrastemma bicolor* sp. nov. Kadiak. Three times natural size.



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PLATE II.

- FIG. 1. *Emplectonema bürgeri* sp. nov. Anterior portion of an individual of the pale variety. Glacier Bay. $\frac{3}{4}$ natural size.
2. *E. bürgeri*. A large individual of the dark variety. Glacier Bay. $\frac{3}{4}$ natural size.
3. *Tæniosoma princeps* sp. nov. Large individual. Yakutat. $\frac{1}{2}$ natural size.
4. *T. princeps*. A contracted specimen in formalin. Cape Fox. Natural size.
5. *Zygonemertes thalassina* sp. nov. Sitka. Twice natural size.
6. *Paranemertes peregrina* sp. nov. Brown variety. Victoria, B. C. A small specimen. Natural size. Compare pl. III, fig. 5.

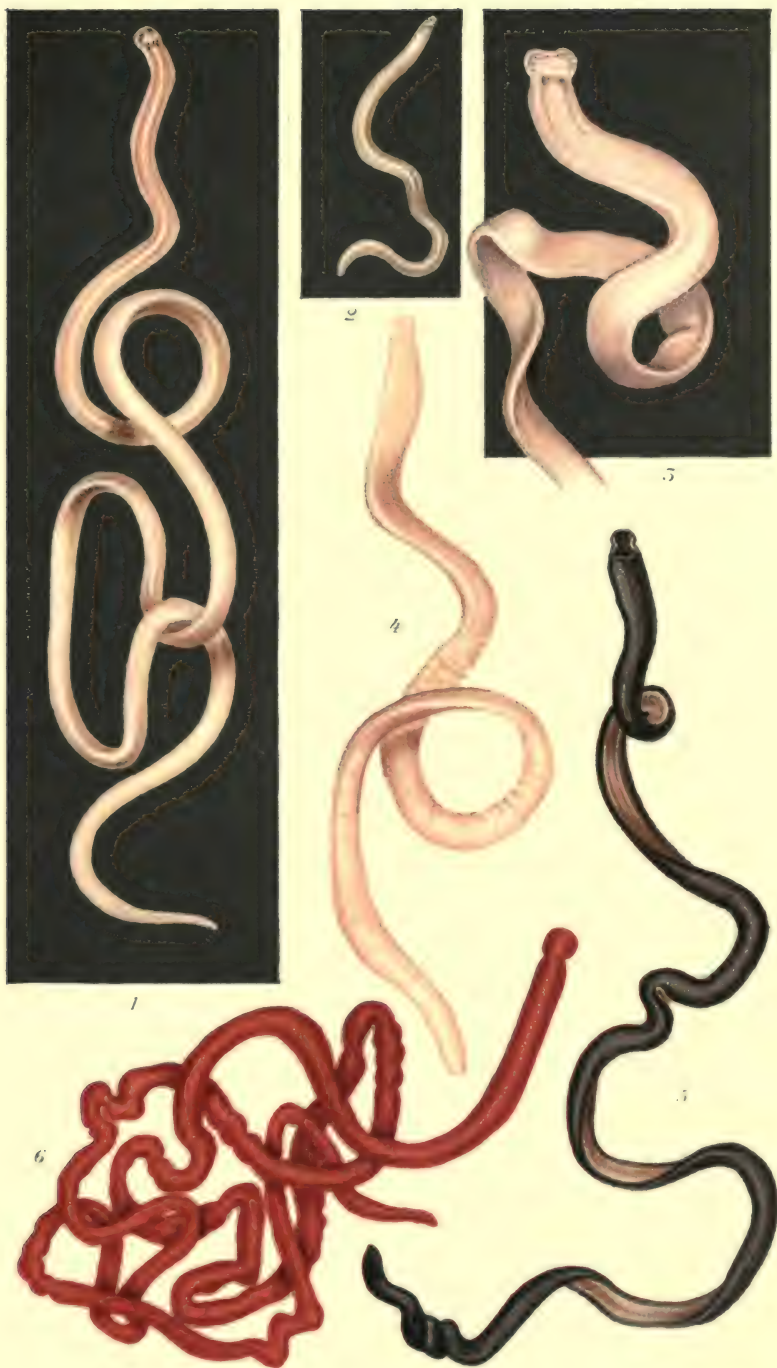


ALASKA NEMERTEANS

W. H. C. & S. S.

PLATE III.

- FIG. 1. *Amphiporus exilis* sp. nov. Glacier Bay. Slightly enlarged.
2. *Zygonemertes albida* sp. nov. Victoria, B. C. Enlarged $1\frac{1}{2}$ times.
3. *Paranemertes carnea* sp. nov. Taku Harbor. Anterior portion of body with emarginate head. Natural size.
4. *P. carnea*. Sitka. $\frac{2}{3}$ natural size.
5. *Paranemertes peregrina* sp. nov. Virgin Bay, Prince William Sound. $\frac{2}{3}$ natural size.
6. *Carinella speciosa* sp. nov. Hot Springs, near Sitka. $\frac{1}{2}$ natural size.



ALASKA NEMERTEANS

[Signature]

PLATE IV.

- FIG. 1. *Amphiporus nebulosus* sp. nov. Kukak Bay, Alaska Peninsula. Natural size.
2. *Micrura alaskensis* sp. nov. Sitka. Enlarged $1\frac{1}{2}$ times.
3. *Cerebratulus albifrons* sp. nov. Near Sitka. Twice natural size.
4. Side view of head of same individual.
5. *Amphiporus tigrinus* sp. nov. Farragut Bay. Mature male specimen, slightly enlarged.
6. *A. tigrinus*. Head of male; dorsal view. Twice natural size.
7. *A. tigrinus*. Farragut Bay. Female with ripe ova. Slightly enlarged.
8. Head of female of same species. Dorsal view. Twice natural size.



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PLATE V.

- FIG. 1. *Micrura verrilli* sp. nov. Virgin Bay, Prince William Sound. Natural size.
2. Side view of head of same species.
3. The same; contracted.
4. *Cerebratulus longiceps* sp. nov. Yakutat. Enlarged $1\frac{1}{2}$ times.
- 5, 6, 7. Heads of same species, from lateral, dorsal, and ventral aspects respectively.
8. *Lincus torquatus* sp. nov. Orca, Prince William Sound. Natural size.
9. *L. torquatus*. Side view of head.
10. *Amphiporus bimaculatus* sp. nov. Victoria, B. C. Natural size.



PLATE VI.

- FIG. 1. *Cerebratulus montgomeryi* sp. nov. Dutch Harbor, Unalaska. Natural size.
2. Head of same species from ventral surface.
3. *Cerebratulus occidentalis* sp. nov. Yakutat. Natural size.
4. *Amphiporus angulatus* (Fabr.) Verrill. Kadiak. Natural size of large specimen.



ALASKA NEMERTEANS

Platyschisma

PLATE VII.

- FIG. 1. *Zygonemertes thalassina*. Outline of stylet apparatus of proboscis ($\times 50$). 1a, 1b, several accessory stylets from two individuals ($\times 225$). Sitka.
2. *Amphiporus angulatus*. Central portion of proboscis ($\times 40$). Taku Harbor. 2a, central stylet and basis of another specimen ($\times 80$).
3. *Paranemertes pallida*. Outline of middle region of proboscis ($\times 60$).
4. *P. carnea*. Extremity of everted proboscis, with six pouches of accessory stylets, of which but four are shown ($\times 35$). Sitka.
5. *Amphiporus exilis*. Middle portion of proboscis, indicating, besides central stylet and basis, eight pouches of accessory stylets ($\times 40$). Yakutat.
6. *Amphiporus leuciodus*. Stylet apparatus of proboscis showing the three accessory stylet pouches ($\times 60$). Victoria, B. C.
7. *Paranemertes peregrina*. Outline of middle portion of proboscis ($\times 50$). Virgin Bay.



PLATE VIII.

- FIG. 1. *Emplectonema bürgeri*. Outline of stylet apparatus ($\times 35$). Glacier Bay.
2. *Amphiporus bimaculatus*. Middle portion of proboscis, with four pouches of accessory stylets ($\times 35$). Glacier Bay.
3. *Emplectonema gracile*. Stylet apparatus of proboscis ($\times 50$). Popof Island.
4. *Amphiporus tigrinus*. Middle region of proboscis ($\times 60$). Farragut Bay. The deeply stained wreath of glands is indicated only in section.
5. *Zygonemertes albida*. Middle portion of proboscis ($\times 40$). Victoria, B. C.
6. *Amphiporus nebulosus*. Outline of stylet apparatus of proboscis ($\times 50$). Kukak Bay.
7. *Paranemertes carnea*. Side view of head, with partially everted proboscis. The position of the lateral oblique furrows, and the arrangement of the ocelli are indicated ($\times 5$). Taku Harbor.

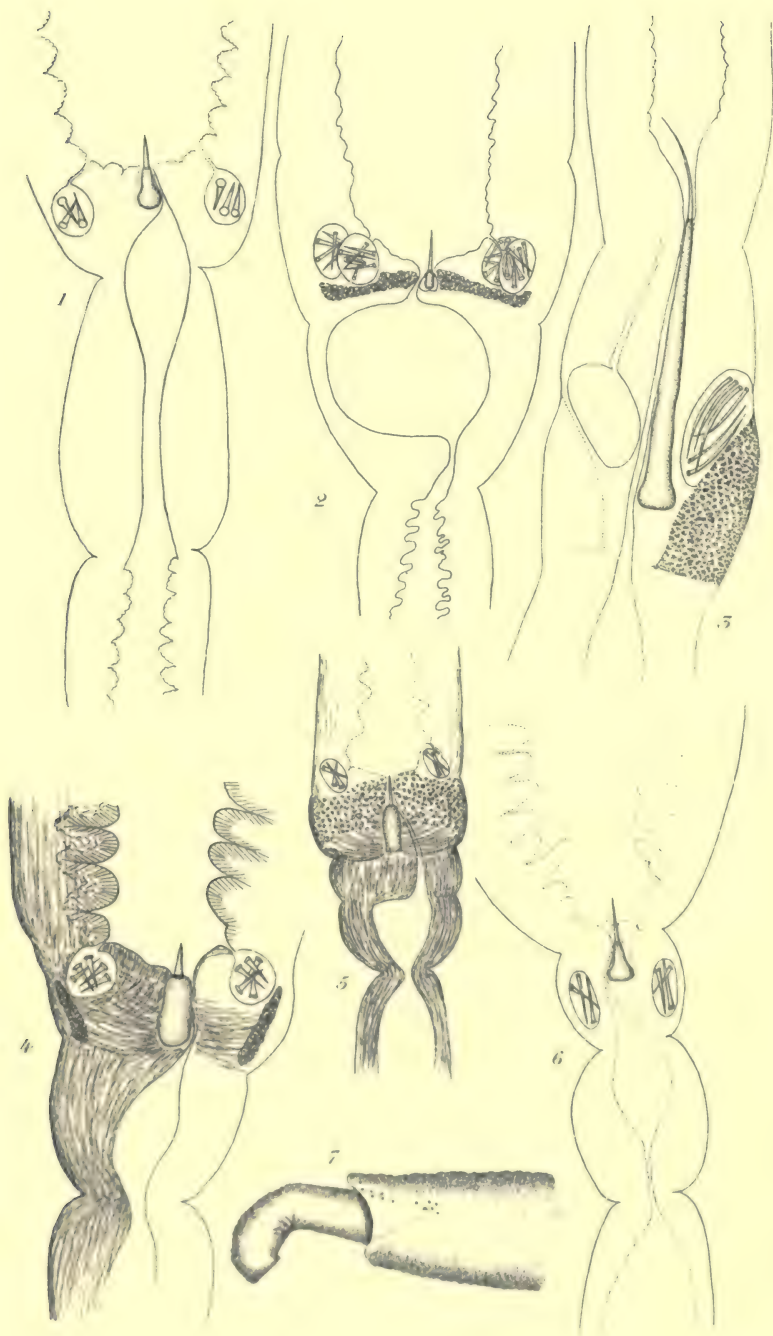


PLATE IX.

FIG. 1. *Carinella speciosa*. Transverse section through head in front of brain showing, particularly, position of enormously developed cephalic glands (*cgl*) and arrangement of cephalic nerves (*nv*). The cephalic glands are thickly placed both above and below the cephalic blood lacunæ (*bl*), as well as around the rhynchodæum (*rh*). The secretion from many of these glands is discharged near the lateral margins as indicated (*dgl*). Between the longitudinal and oblique muscles (*lm*), which lie in the deeper parts of the head, and the circular fibrous layer (*cm*), composed of muscles and connective tissue fibers underlying the integument (*i*), are numerous and very massive nerves (*nv*) which supply the head regions in front of the brain. The broad indentation on the ventral margin has no relation to the mouth, which lies much farther back. Other reference letters are explained above (p. 83). A small individual. ($\times 45$).

2. *Carinella speciosa*. Transverse, but somewhat oblique, section through head in region of brain. On the right of the section the brain (*dg* and *vg*) lies directly beneath the circular fibers (*cm*). External to the brain, and lying among the bases of the integumental cells, is the highly specialized cerebral sense organ (*cso*), connected with the dorsal ganglion (*dg*) by several small nerves (*sn*). The cerebral sense organ shows a conspicuous central canal. The rhynchodæum (*rh*) has lost its fringe of gland cells, these being limited to the regions anterior to it. The outer portion of the circular layer (*cm*) constitutes the basement membrane of the integument. In the region of the brain the circular layer splits into two sheets, one passing external to the brain and the other (*if*) internal. Other reference letters as above. A large specimen. ($\times 25$).

3. *Carinella speciosa*. Transverse section through nephridial region showing positions, and one of the openings, of the nephridial canals. The lateral blood lacuna (*lv*) and the nephridial canal (*nef*) lie embedded in a band of loose connective tissue on each side. The opening of one of the efferent nephridial ducts (*nd*) is seen on the right of the drawing. Other reference letters as indicated above. ($\times 25$).

PLATE X.

- FIG. 1. *Carinella speciosa*. Portion of transverse section through nephridial region. The ciliated nephridial canal (*neφ*) shows the peculiar infolding of the integumental cells on its dorsal border. These integumental cells are here loosely arranged, and show several deep infoldings (*op*) which, under certain circumstances, may possibly have a more or less distinct communication with the nephridial canal. But a small portion of the closely packed gland cells in the integument are indicated. Reference letters are explained on p. 83. ($\times 75$).
2. *Carinella speciosa*. Portion of a transverse section through the brain region. The relation of the dorsal ganglion (*dg*) with the highly specialized cerebral sense organ (*cs*) is indicated. The ciliated canal (*cc*) of the sense organ connects directly with the exterior by a narrow tube (*sop*)—shown in dotted lines in the drawing, because it lies mainly in another section—opening on the lateral margin of the head. Several nerves (*sn*) are seen to pass from the dorsal ganglion to the sense organ. Other reference letters as above. Only a small portion of the integumental gland cells are shown. ($\times 75$).
3. *Amphiporus tigrinus*. Dorsal view of anterior portion of body, cleared in cedar oil. In front of the brain the arrangement of the ocelli is shown, and farther back the position of the ovaries (*ov*). The intestinal caeca are not indicated. Farragut Bay. ($\times 8$).
4. *Amphiporus tigrinus*. Median sagittal section through the anterior portion of the body. The cephalic glands (*cgl*) lie above the opening of the rhyncodæum (*ro*). The mouth (*m*) separates from the proboscis opening a little way back. The attachment (*ap*) of the proboscis to the tissues of the head is seen to be well in front of the brain commissures (*dc* and *vc*). The section shows the comparative size and arrangement of the proboscis, blood vessels, esophagus, and other organs. Reference letters as above. ($\times 30$).

PLATE XI.

- FIG. 1. *Amphiporus nebulosus*. Transverse section through posterior portion of ventral commissure of brain. The submuscular glands (*smg*) fill up a large portion of the tissues of the ventral half of the head. The pair of nerves leading forward to the cerebral sense organs is seen to originate (*son*) from the ventral side of the dorsal ganglia. Other reference letters are explained on p. 83. ($\times 26$).
2. *Amphiporus angulatus*. Transverse section through ventral commissure of brain. The dorsal attachment of the proboscis to the tissues of the head is shown. The proboscis nerves (*pn*) enter the ventral side of the proboscis, and divide into a definite number of branches (usually 18), which farther back arrange themselves symmetrically about the periphery. The roots of the dorsal brain commissure (*rdc*) are indicated. In the right half of the section the anterior ends of the nephridial tubules (*nep*) are seen. Submuscular glands (*smg*) are not as numerous as in *A. nebulosus*. Other reference letters as above. ($\times 26$).
3. *Amphiporus exilis*. Transverse section through nephridial region to show efferent nephridial ducts (*nep*) opening on dorso-lateral aspects of body. This condition is extremely rare in Metanemertean. Several diverticula of the intestinal cæcum (*inc*) are represented. Other reference letters as above. ($\times 32$).

PLATE XII.

FIG. 1. *Paranemertes pallida*. Transverse section through nephridial region.

In this case the single pair of efferent nephridial ducts (*neφ*) was so symmetrically placed that both were cut in a single section. The very small size of the proboscis (*ps*) in the large proboscis sheath (*psk*) is remarkable. The intestinal cæcum (*ic*) shows lateral diverticula above the lateral nerve cords. ($\times 18$).

2. *Amphiporus bimaculatus*. Transverse section of proboscis. The 16 proboscis nerves (*pn*) are very sharply defined. The cylindrical plexus (*np*) of nerve fibers and connective tissue serves to connect the nerves, and divides the thick longitudinal muscular band into an inner (*plm*) and an outer (*plm'*) layer. The inner longitudinal muscular layer, found in most related species, is wanting—the basement layer (*bm*) of the internal epithelium (*pep*) lying immediately beneath the circular muscular layer. ($\times 66$).

3. *Emplectonema bürgeri*. Transverse section through body, showing manner in which the esophagus (*e*) opens into dorsal wall of intestine (*in*). This section also shows the genital pouches (*gp*) lying both above and below the intestinal lobes, and indicating that they open respectively on the dorsal and ventral surfaces of the body. Of the submuscular glands (*smg*), which extend throughout the esophageal region in great abundance but a few remain as far back as the position of the section figured. ($\times 20$).

PLATE XIII.

- FIG. 1. *Micrura alaskensis*. Transverse section through mouth region. The peculiar accessory buccal glands (*bg'*) are seen to lie outside the circular muscular layer (*cm*), and amongst the fibers of the outer longitudinal muscular layer (*olm*). Their secretion passes through the layer of circular muscles, and mixes with that of the true buccal glands (*bg*), which lie immediately beneath the epithelium of the mouth (*mep*). The buccal nerves (*bn*) lie on the lateral borders of the mouth as usual. Other reference letters are explained on p. 83. ($\times 30$).
2. *Zygonemertes thalassina*. Transverse section immediately back of the brain. The intestinal cæca (*ic*) reach forward to abut against the dorsal ganglia. The ocelli (*oc*) extend back of the brain, and occupy positions, as shown, immediately above and external to the lateral nerve cords (*ln*). ($\times 100$).
3. *Amphiporus angulatus*. Transverse section through posterior end of body. The drawing is slightly diagrammatic, as it contains portions of the two adjacent sections. The anastomosis of the three longitudinal blood vessels (*bva*) is seen to lie immediately dorsal to the commissure (*nc*) of the lateral nerves (*ln*); the basement layer (*bm*) is remarkably thick in this region. The posterior end of the intestine (*in*) opens ventrally a few sections farther back. Other reference letters are explained above. ($\times 80$).

NEMERTEANS OF THE PACIFIC
COAST OF NORTH AMERICA

PART II

NEMERTEANS OF THE PACIFIC COAST OF NORTH AMERICA

PART II

BY WESLEY R. COE, PH.D.

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INTRODUCTION

SINCE the publication of the report on the Nemerteans collected on the Harriman Alaska Expedition,¹ I have had an opportunity of studying extensive collections of this group of worms from Alaska and from other portions of the Pacific coast of North America. The report on these collections is soon to appear in the Bulletin of the Museum of Comparative Zoölogy. I have also found opportunity to spend a summer on the coast of California,² where I obtained a considerable

¹Published in Proc. Wash. Acad. Sci., III, pp. 1-110, pls. I-XIII, March, 1901.

²To Dr. Wm. E. Ritter, of the University of California, for the hospitality of the Marine Laboratory at San Pedro, and to Dr. C. H. Gilbert, of Stanford University, for similar privileges at the Hopkins Seaside Laboratory at Pacific Grove, the writer wishes to express his most cordial thanks. The writer is also indebted to Professor C. B. Wilson, of Westfield, Mass., for numerous specimens and very valuable notes on California Nemerteans; and to Mr. J. F. Abbott, formerly of Stanford University, for numerous important notes and drawings from specimens collected at Monterey Bay, Calif.

number of species which were not collected on the Harriman Expedition, and a large proportion of which have proved to be new to science.

A study of the Nemerteans of the California coast reveals the fact that a number of the Alaska species extend southward throughout the whole length of the State, and that many others occur as far south as Monterey Bay. We may thus expect that many of those forms which I have more recently found in California may range northward into Alaska, so that their incorporation in the report on the Alaska species can by no means be out of place.

In the following pages I shall not attempt to describe all the species which have come into my hands from the Pacific coast, but shall here confine myself to those forms which I had an opportunity of collecting personally and studying while they were still alive. The specific descriptions can thus be made far more precise and exhaustive than when preserved material only is to be had. In all cases, however, serial sections have been carefully studied to determine the anatomical peculiarities of each species recorded.

The most strikingly colored forms were drawn as nearly as possible in their natural colors, and an attempt was made to reproduce the natural shape and characteristic position of the body when alive.

A single species (*A. paulinus*) has been described by Punnett¹ from the Pribilof Islands, Bering Sea, since the first portion of this report appeared. A brief description of this species will be found on p. 155.

At the time of publishing the first portion of the report, I was unfortunately unaware that a preliminary paper by the late B. B. Griffin on Some Marine Nemerteans of Puget Sound and Alaska² had appeared since the death of this enthusiastic young investigator. Several of the species very briefly described by Griffin were through this oversight redescribed by me in my previous paper with names which must be now relegated to synonymy. Griffin's drawings, notes, and collections have recently

¹ Proc. Zool. Soc. London, p. 92, 1901.

² Ann. New York Acad. Sci., XI, pp. 193-217, 1898.

been placed in my hands, so there can be no doubt as to the identity of these forms. They are:

1. *Carinella dinema* Coe = *C. sexlineata* Griffin.
2. *C. speciosa* Coe = *C. rubra* Griffin.
3. *Carinoma griffini* Coe = *C. mutabilis* Griffin.
4. *Amphiporus leuciodus* Coe = *A. imparispinosus* Griffin.
5. *A. exilis* Coe = *A. formidabilis* Griffin.

Griffin's paper includes twelve named species besides two forms which are not designated by specific names. The geographical distribution of these is as follows:

1. *Carinella sexlineata* Griffin. Puget Sound; Sitka, Alaska.
2. *C. rubra* Griffin. Puget Sound; Sitka, Alaska.
3. *Carinoma mutabilis* Griffin. Puget Sound; Strait of Juan de Fuca. Varieties: *argillina*, in hard blue clay; *vasculosa*, in sand between tides.

4. *Emplectonema viride* Stimpson = *E. gracile* (Johnston) Verrill. Southern Alaska; Puget Sound.

5. *E. violaceum* Griffin, (*non* Bürger) = *E. bürgeri* Coe. This form, which Griffin considers identical with Bürger's species from the coast of Chile,¹ was found on piles at Port Townsend, Puget Sound. Griffin's description is substantially as follows: Body extremely flattened, ribbon-like; head rounded in front, directly continuous with body; eyes numerous. Color somewhat variable, with fairly constant pattern on dorsal surface which is densely flecked with purple or brown upon a pale yellowish brown ground color; ventral surface yellowish white. Length probably 50 cm., although it was difficult of measurement because the body remained coiled up in tangled knots in an enormous amount of slime which the worm secretes. These characters agree in the main with the brownish variety of *E. bürgeri*, but differ widely from Bürger's *E. violaceum*, which is dark brownish violet above and pale rose-violet on ventral surface even after preservation. Griffin considers the internal anatomy to agree 'more or less closely' with Bürger's *E. violaceum*. My own preparations, however, prove conclusively that the two species are specifically distinct, for they differ decidedly in the only really specific anatomical character which Bürger gives;

¹ Zool. Jahrb., Abth. d. Syst., ix, p. 272, 1896.

viz., in *E. violaceum* the cerebral sense organs are very small, and lie far in front of brain, while in *E. bürgeri* they are remarkably large for the genus and lie only slightly in front of brain.¹ The practical absence of cephalic glands is in accord with most species of the genus. Neither Bürger nor Griffin makes any statements in regard to the proboscis, which usually presents the most tangible specific characters.

6. *Amphiporus imparispinosus* Griffin. Sitka, Alaska; Puget Sound.

7. *A. formidabilis* Griffin. Alaska and Puget Sound

8. *A. brunneus* Griffin. Port Townsend, Puget Sound. Presents the following peculiarities: Length in alcohol 3.3 cm.; width 5 mm. Color in life dark brown or smoky black dorsally, greenish or yellowish white ventrally; on each side of neck is a pale, angular spot. Cephalic glands moderately developed; cephalic sense organs considerably in front of brain. Intestinal cæca reach nearly to brain. Basis of central stylet long; two lateral pouches with two (or three ?) stylets each.

In some respects this description agrees with the characters of *Paranemertes peregrina*, which is common in Puget Sound, but on the following page (p. 213) the species is represented as bearing "a more or less general resemblance to *A. angulatus*." There can hardly be said to be the slightest resemblance between *P. peregrina* and *A. angulatus*, so that even with Griffin's notes and material at hand, there being no specimens of this form it is impossible to determine to which, if any, of the described species this *A. brunneus* belongs. For the present it is necessary therefore to consider it as a distinct species.

9. *A. angulatus* (Fabr.) Verrill. Sitka and Redout Bay, Alaska. Doubtfully referred to this species by Griffin; several varieties obtained. This species is abundant along the whole coast, from Bering Strait to Puget Sound.

10. *A. drepanophoroides* Griffin. No locality given. Length 4-5 cm. or less; form short and stout; color red above, white beneath; eyes numerous, in rows along antero-lateral margins of head. Cephalic and submuscular glands prominent. Cerebral sense organs large, situated beside brain and extending pos-

¹Coe, Proc. Wash. Acad. Sci., III, p. 26, 1901.

teriorly behind dorsal ganglia; canals open in front of ventral commissure. Differs from all the preceding species in smallness of rhynchocœl, which is enclosed in a thick muscular sheath in which longitudinal and circular muscles are interwoven. No intestinal cœcum; circular muscle-layer quite thick.

The species is known only from the above description, and is truly remarkable because of the absence of the intestinal cœcum. No specimens or slides showing any such peculiarity were contained in Griffin's collections, however, when they were turned over to the writer.

11. *Lineus striatus* Griffin. Puget Sound. Color notes and drawings lost by shipwreck. "Color brownish red on dorsum, sharply marked off laterally from the much lighter ventral portion. Dorsum marked by numerous creamy white transverse bands which cease at demarcation-line between the dorsal and ventral coloring. Tip of head brilliant red. Length probably not over 4 cm." Nephridia have numerous efferent ducts.

These characters resemble those of very small individuals of *M. verrilli* in many respects, and the two species may possibly be identical. Perhaps Griffin's form is more closely similar to Stimpson's *Cerebratulus impressus* (= *Micrura impressa*) from Bering Strait.

12. *Cerebratulus marginatus* Renier. Puget Sound.

13. *Lineus* sp.? Puget Sound. Smoky black with greenish tinge dorsally, grayish brown ventrally. Probably = *Lineus viridis* (Fabr.) Johnston, which is recorded from southern Alaska (Coe, *loc. cit.*, p. 65).

14. *Cerebratulus* sp.? A very large, dark species with flesh-colored margins; fragments measuring nearly 20 mm. in diameter after preservation. No locality given, but the species is in all probability *C. herculeus* Coe, which is also recorded from southern Alaska.

Careful comparison of Griffin's notes, drawings, and material indicates that eight of the twelve above-named species were new at time of publication. Five of the eight must be retained in place of five of my own names, as stated above. Two other new species (*Amphiporus brunneus* and *A. drepanophoroides*) cannot be referred to any forms which have come into my

hands, and must stand as new for the present. One other species (*E. bürgeri* Coe), although undescribed at the time, was incorrectly referred to *E. violaceum* Bürger. Three of the four remaining forms were correctly identified with European species, while the one species remaining, *Lineus striatus*, is possibly identical with *M. impressa* (Stimpson), as stated above.

ALASKA SPECIES FOUND ON THE COAST OF CALIFORNIA

Of the species recorded in the first part of this report (pp. 1-110), the following were collected in the summer of 1901 on the California coast in the localities indicated below.

Paleonemertea.

1. *Carinella capistrata* Coe. Monterey Bay.
2. *C. sexlineata* Griffin (= *C. dinema* Coe). Monterey Bay; San Pedro.
3. *Carinoma mutabilis* Griffin (= *C. griffini* Coe). San Pedro.
4. *Cephalothrix linearis* (Rathke) Oersted. Monterey Bay; San Pedro; San Diego.

Hoplonemertea.

5. *Emplectonema gracile* (Johnston) Verrill. Monterey Bay.
6. *Paranemertes peregrina* Coe. Monterey Bay; San Pedro.
7. *Amphiporus bimaculatus* Coe. Monterey Bay.
8. *A. angulatus* (Fabr.) Verrill. Monterey Bay; San Pedro.
9. *A. imparispinosus* Griffin (= *A. leuciodus* Coe). Monterey Bay; San Pedro; San Diego.
10. *A. formidabilis* Griffin (= *A. exilis* Coe). Monterey Bay.

Heteronemertea.

11. *Micrura verrilli* Coe. Monterey Bay.
12. *M. alaskensis* Coe. San Pedro; Monterey Bay.
13. *Cerebratulus marginatus* Renier. San Pedro.
14. *C. albifrons* Coe. San Pedro

In the first portion of this report 32 species were enumerated. Nearly half of these, or the above 14 species, were found also on the California coast during a single summer. Eleven of

these forms, which are common both to the California coast and to Alaska, were found at Monterey Bay, ten at San Pedro or in the deep water in the vicinity, while only two were collected at San Diego, and these were both common in the other two localities. At San Diego, however, the opportunities for collecting were comparatively limited, and but a short time was spent at that place. Of the ten Alaska species found at San Pedro, five only were collected at Monterey Bay, although in all probability the others will be found to occur there.

There can be no doubt that future collections will add materially to the number of forms whose range extends from Alaska at least as far southward as Monterey Bay or even to Point Conception. And while this is a considerable range geographically, yet the environmental conditions of the marine forms are not greatly different between Monterey Bay, Puget Sound, Sitka, and the eastern Aleutian Islands. The temperature of the water is but a few degrees different, and in some seasons of the year is actually warmer on the coast in portions of Alaska than it is in Puget Sound or even in the deeper water off the California coast.

SPECIES NEW TO WEST COAST OF NORTH AMERICA

In addition to the species recorded in the previous paper (pp. 1-110), the following forms have since been studied, and are described in this article. In accord with Bergendal's recommendation¹ the orders Protonemertea and Mesonemertea of Bürger are placed together under the older order Paleonemertea proposed by Hubrecht.

Paleonemertea.

1. *Carinella frenata* sp. nov. San Pedro, Calif. Not common.
2. *C. albocincta* sp. nov. Off San Pedro, Calif., in 50-100 fms. Common.
3. *C. cingulata* sp. nov. Monterey Bay, Calif., in 14 fms. Not common.

Hoplonemertea.

4. *Nemertopsis gracilis* sp. nov. Monterey Bay, Calif. Not common.

¹ Kongl. Vetenskaps-Akad. Förhandlingar, pp. 721-742, 1900.

5. *Paranemertes californica* sp. nov. Southern coast of California. Not uncommon.

6. *Carcinonemertes epialti* Coe. Parasitic on the crab, *Epi-
altus productus*. Monterey Bay, Calif.

7. *Amphiporus cruentatus* Verrill. San Pedro and Monterey Bay, Calif. Rather common.

8. *Tetrastemma signifer* sp. nov. San Pedro, Calif. Not very common.

9. *T. nigrifrons* sp. nov. Monterey Bay, Calif. Abundant.

10. *T. bilineatum* sp. nov. San Diego, Calif. Common.

11. *T. quadrilineatum* sp. nov. San Pedro, Calif. Rather common.

12. *T. (Ærstedtia) dorsale* (Abildgaard) McIntosh. Monterey Bay, Calif., in 20 fms. Not very common.

13. *T. (Ærstedtia) reticulatum* sp. nov. San Pedro, Calif. Common.

Heteronemertea.

14. *Taniosoma punnetti* sp. nov. Off San Pedro, 50 fms.; Monterey Bay, Calif., 5-20 fms. Common.

15. *Zygeupolia littoralis* C. B. Thompson. San Pedro, Calif. Common.

16. *Lineus rubescens* sp. nov. San Pedro and Monterey Bay, Calif. Not common.

17. *L. flavescens* sp. nov. Low water to 50 or more fms., off San Pedro, Calif. Common.

18. *L. pictifrons* sp. nov. San Pedro, Calif. Rather common.

19. *L. albolineatus* sp. nov. Off San Pedro and in Monterey Bay, Calif. Not common.

20. *L. wilsoni* sp. nov. Monterey Bay, Calif. Common.

21. *Micrura nigrirostris* sp. nov. San Pedro, Calif. Not common.

Besides those mentioned in the above list, which includes only species which have not been hitherto recorded from the Pacific coast of North America, a considerable number of forms described in the first part of this paper (pp. 11-84) as occurring in Alaska have since been found in other localities, notably on the

California coast, as mentioned above, and have thus had the range of their distribution greatly extended.

DISTRIBUTION OF ALL SPECIES KNOWN FROM THE WEST COAST
OF NORTH AMERICA

Including the foregoing and those which are described on the following pages, 57 species of Nemerteans are at present known from the Pacific coast, and their distribution as far as recorded (including my own observations during the summer of 1901 and the study of several other collections) is as follows:

Paleonemertea.

1. *Carinella rubra* Griffin. Whole Pacific coast of Alaska to Vancouver Island, B. C.

2. *C. sexlineata* Griffin. Sitka, Alaska, to San Pedro, Calif.

3. *C. capistrata* Coe. Prince William Sound, Alaska, to Monterey Bay, Calif.

4. *C. frenata* sp. nov. San Pedro, Calif.

5. *C. albocincta* sp. nov. Off San Pedro, Calif.

6. *C. cingulata* sp. nov. Monterey Bay, Calif.

7. *Carinoma mutabilis* Griffin. Vancouver Island, B. C., to San Pedro and San Diego, Calif.

8. *Cephalothrix linearis* (Rathke) Oersted. Whole Pacific coast of Alaska to southern coast of California; New England; northern coasts of Europe; Mediterranean Sea.

Hoplonemertea.

9. *Emplectonema gracile* (Johnston) Verrill. Whole Pacific coast of Alaska to Monterey Bay, Calif.; northern coasts of Europe; Mediterranean Sea; Madeira.

10. *E. bürgeri* Coe. Southern coast of Alaska to Puget Sound.

11. *Zygonemertes thalassina* Coe. Sitka, Alaska.

12. *Z. albida* Coe. British Columbia.

13. *Nemertopsis gracilis* sp. nov. Monterey Bay, Calif.

14. *Paranemertes peregrina* Coe. Whole Pacific coast of Alaska to southern coast of California.

15. *P. pallida* Coe. Pacific coast of Alaska.

16. *P. carnea* Coe. Pacific coast of Alaska and British Columbia.

17. *P. californica* sp. nov. Southern coast of California.

18. *Carcinonemertes epialti* Coe. Parasitic on *Epialtus*. Monterey Bay, Calif.

19. *Amphiporus angulatus* (Fabr.) Verrill. Bering Strait to Puget Sound; New England to Greenland.

20. *A. bimaculatus* Coe. Southern Alaska; Puget Sound to Monterey Bay, Calif.

21. *A. tigrinus* Coe. British Columbia.

22. *A. nebulosus* Coe. Pacific coast of Alaska Peninsula.

23. *A. cruentatus* Verrill. Monterey Bay and San Pedro, Calif.; southern coast of New England.

24. *A. imparispinosus* Griffin. Pacific coast of Alaska to southern coast of California.

25. *A. formidabilis* Griffin. Aleutian Islands, Alaska, to Monterey Bay, Calif.

26. *A. paulinus* Punnett. Pribilof Islands, Bering Sea.

27. *A. brunneus* Griffin. Puget Sound.

28. *A. drepanophoroides* Griffin. Puget Sound.

29. *Tetrastemma signifer* sp. nov. San Pedro, Calif.

30. *T. nigrifrons* sp. nov. Monterey Bay, Calif.

31. *T. bicolor* Coe. Kadiak, Alaska.

32. *T. aberrans* Coe. Pacific coast of Alaska.

33. *T. cæcum* Coe. Kadiak, Alaska.

34. *T. bilineatum* sp. nov. San Diego, Calif.

35. *T. quadrilineatum* sp. nov. San Pedro, Calif.

36. *T. (Ærstedtia) dorsale* (Abildgaard). Monterey Bay, Calif.; northern coasts of Europe; Mediterranean Sea; east coast of United States.

37. *T. (Ærstedtia) reticulatum* sp. nov. San Pedro, Calif.

Heteronemertea.

38. *Tæniosoma princeps* Coe. Southeastern coast of Alaska.

39. *T. punnetti* sp. nov. Monterey Bay and San Pedro, Calif.

40. *Zygeupolia littoralis* C. B. Thompson. San Pedro, Calif.; New England (Woods Hole, Mass.).

41. *Lineus viridis* (Fabr.) Verrill. Southeastern coast of Alaska.
42. *L. torquatus* Coe. Pacific coast of Alaska.
43. *L. rubescens* sp. nov. Monterey Bay and San Pedro, Calif.
44. *L. flavescens* sp. nov. Southern coast of California.
45. *L. pictifrons* sp. nov. San Pedro, Calif.
46. *L. wilsoni* sp. nov. Monterey Bay, Calif.
47. *L. albolineatus* sp. nov. Monterey Bay and San Pedro, Calif.
48. *Micrura nigrirostris* sp. nov. San Pedro, Calif.
49. *M. verrilli* Coe. Pacific coast of Alaska to Monterey Bay, Calif.
50. *M. impressa* (Stimpson) Coe. Bering Strait; Puget Sound (?)
51. *M. alaskensis* Coe. Pacific coast of Alaska.
52. *Cerebratulus herculeus* Coe. Southeast coast of Alaska; Puget Sound.
53. *C. marginatus* Renier. Southeastern coast of Alaska to southern coast of California; New England to Greenland; northern coasts of Europe; Mediterranean Sea.
54. *C. occidentalis* Coe. Pacific coast of Alaska to British Columbia.
55. *C. longiceps* Coe. Yakutat Bay, Alaska.
56. *C. montgomeryi* Coe. Aleutian Islands, Alaska, to Puget Sound.
57. *C. albifrons* Coe. Southeastern coast of Alaska to southern coast of California.

Of the above 57 species known from the Pacific coast of North America, only 7 have been recorded in other parts of the world. Of these seven species three — *Cephalothrix linearis*, *Tetrastemma dorsale* and *Cerebratulus marginatus* — occur also both on the east coast of North America and in Europe; three others — *Amphiporus angulatus*, *A. cruentatus* and *Zygeupolia littoralis* — are found in New England, but are not known from Europe; while a single species — *Emplectonema gracile* — is common in Europe, but has not been recorded from the east coast of America.

Although such a large proportion of the species are peculiar to the Pacific coast, yet in general they belong to common European genera, and the Nemertean fauna as a whole resembles that of Europe and the Mediterranean far more closely than it does that of the Atlantic coast of North America. This has been observed in regard to the general invertebrate fauna of Puget Sound by Harrington and Griffin,¹ and Griffin noted the same in regard to the Nemerteans. The abundance of species of *Carinella*, the presence of *Nemertopsis* and of *Emplectonema gracile*, and the close resemblance of a number of species of *Tetrastemma*, *Amphiporus*, *Lineus*, *Micrura* and *Cerebratulus* to closely related European forms, are instances of this similarity of faunas.

Certain other collections which are being studied will doubtless yield further light on the distribution of the species and their relationships, as well as the resemblance of the Nemertean fauna of the Pacific coast to that of other parts of the world.

The distribution of Nemerteans on the Pacific coast of North America so far as now known is represented in the following table :

NUMBER OF SPECIES KNOWN FROM VARIOUS LOCALITIES ON THE
PACIFIC COAST

Genus.	Alaska.	Puget Sound.	Central California.	Southern California.	Total.
PALEONEMERTEA.					
<i>Carinella</i> .	3	3	3	3	6
<i>Carinoma</i> .	—	1	1	1	1
<i>Cephalothrix</i> .	1	1	1	1	1
HOPLONEMERTEA.					
<i>Emplectonema</i> .	2	2	1	—	2
<i>Zygonemertes</i> ,	1	1	—	—	2
<i>Nemertopsis</i> .	—	—	1	—	1
<i>Paranemertes</i> .	3	2	2	2	4
<i>Carcinonemertes</i> .	—	—	1	—	1
<i>Amphiporus</i> .	6	7	4	2	10
<i>Tetrastemma</i> .	3	—	2	4	9
HETERONEMERTEA.					
<i>Tæniosoma</i> .	1	—	1	1	2
<i>Zygeupolia</i> .	—	—	—	1	1
<i>Lineus</i> .	2	—	3	4	7
<i>Micrura</i> .	3	?	2	2	4
<i>Cerebratulus</i> .	6	5	2	2	6
Total.	31	22	24	23	57

¹Trans. New York Acad. Sci., p. 161, 1897.

The total number of species already recorded from the region covered by this report is surprisingly large, considering the few attempts at their collection. And it should be remarked that we find in this region not only a large number of species, but also a surprising abundance of individuals of the species represented. It now seems probable that this coast will eventually be found to possess more species of Nemerteans than any other region of equal size on the globe. And certainly I know of no locality where so large a proportion of the invertebrate animals found in a miscellaneous collection belong to the Nemerteans as on the northwest coast of North America.

KEY TO THE PACIFIC COAST NEMERTEANS DESCRIBED ON THE FOLLOWING PAGES

This key is arranged for use in connection with the one published in the former portion of this report (pp. 7-11), and is likewise based mainly on superficial and easily distinguishable characters.

Order *Paleonemertea*.¹

Body remarkably long, soft, fragile. Head distinctly marked off from body, usually broader than neck, often flattened dorso-ventrally *Carinella*.

1. Body large, rather firm, only moderately slender, attaining a length of 50 cm. or more, pale yellowish or rosy, sometimes with greenish tinge; with three longitudinal velvety, blackish lines and a series of narrow rings of similar color.

C. frenata, p. 129.

2. Body firm, rather stout, upwards of 30 cm. long, deep red with a series of narrow white rings..... *C. albocincta*, p. 136.

3. Body slender, subcylindrical, 15 cm. or more in length, deep brown, with a series of white rings and four longitudinal white lines, of which two are lateral, while the other two divide dorsal surface of body into three equal parts... *C. cingulata*, p. 138.

Order *Hoplonemertea*.

- I. Body very slender, almost filiform, somewhat flattened; with four large ocelli; with central stylet and two pouches of accessory stylets. Proboscis sheath about one-third as long as body.

Nemertopsis.

¹As stated above, Bürger's orders *Protonemertea* and *Mesonemertea* are here united into the older order *Paleonemertea* Hubrecht.

1. Length 15 cm. or more; very pale brown or whitish, with two longitudinal dorsal stripes of deep brown; proboscis provided with eight nerves *N. gracilis*, p. 142.
- II. Body moderately elongated; proboscis sheath about one-half to three-fourths the length of the body; central stylet well developed.....*Paranemertes*.
 1. Four or six pouches of accessory stylets; proboscis with ten large nerves. Translucent, pale orange anteriorly, flesh color, grayish or very pale salmon posteriorly, color much obscured by deep green of intestinal tract.....*P. californica*, p. 144.
- III. Body very small and slender; two ocelli; proboscis but little developed, central stylet minute; no accessory stylets; parasitic on crabs *Carcinonemertes*.
 1. Only 4-6 mm. long when sexually mature; color orange or reddish; parasitic on the egg masses of *Epialtus* and perhaps other crabs..... *C. epialti*, p. 151.
- IV. Body rather short and thick; proboscis sheath reaches nearly or quite to posterior end of body; proboscis large, central stylet well developed.
 - aa. Ocelli do not extend posteriorly beyond the brain; basis of central stylet usually rounded posteriorly.
 - bb. Body not very small. Ocelli usually numerous.

Amphiporus.

 1. Rather slender, 10-25 mm. in length; yellow; very conspicuous red blood vessels; five to ten ocelli in single row on each side of head; basis very slender, about same length as stylet..... *A. cruentatus*, p. 154.
 2. Slender, 50-90 mm. in length; proboscis sheath about six-sevenths the length of body; proboscis with fifteen nerves; basis of same length as stylet; ocelli numerous.

A. paulinus, p. 155.
 - bb. Body very small. Ocelli few; usually four well developed ocelli arranged in a rectangle *Tetrastemma*.
 1. Rather slender, 15-25 mm. in length, reddish-brown both above and below, except head, which is white with sharply marked wreath of deep brown color on dorsal surface. Blood corpuscles red.

T. signifer, p. 156.
 2. Usually 20 to 70 mm. in length; head provided with two pairs of very conspicuous, lateral, oblique furrows. Color very variable, except head which is

white with shield-shaped or triangular marking of deep brown color on dorsal surface. Body deep purple, deep brown with white dorsal longitudinal band, reddish with brown flecks, pale brownish or buff on dorsal surface; of similar color, but paler, and often with white longitudinal band on ventral surface. Blood corpuscles red.

T. nigrifrons, p. 159.

3. Only 5 to 10 mm. in length, flesh color, creamy or grayish, with two deep brown longitudinal stripes on dorsal surface.....*T. bilineatum*, p. 164.
4. Usually 8 to 12 mm. in length; whitish, with four deep brown longitudinal stripes, of which two lie on lateral margins and two on dorsal surface.

T. quadrilineatum, p. 166.

5. Firm, cylindrical, slender, body only 8 to 15 mm. in length; flesh color or yellowish, mottled, especially on dorsal surface, with brownish blotches and dots of various shades, often mainly collected into a series of transverse bands.

T. (Oerstedia) dorsale, p. 169.

6. Firm, cylindrical, slender, 8 to 15 mm. in length. White, with large rectangular and longitudinal, dark brown markings almost covering dorsal surface. Often with sixteen pairs rectangular marks and pair of lateral brown lines in addition to bilobed marking on dorsal surface of head. In some varieties markings fuse together.

T. (Oerstedia) reticulatum, p. 170.

Order Heteronemertea.

- A. Head without deep, lateral, longitudinal furrows. Proboscis musculature of two layers, an outer circular and inner longitudinal layer, without muscular crossings*Tæniosoma*.
1. Body large, soft, flabby, 40 to 60 cm. or more in length. Color brownish red or mahogany; tip of snout darker brown with terminal white border ..*T. punnetti*, p. 173.
- AA. Head without deep, lateral, longitudinal furrows. Cerebral sense organs open into pit on margins of acutely pointed head. Proboscis musculature of two layers, outer longi-

tudinal and inner circular layer, with muscular crossings.

Caudal cirrus present *Zygeupolia*.

1. Rather slender, 5 to 8 cm. in length; head pure white, acutely pointed; esophageal region whitish, pale yellow or flesh color; intestinal region rose, pale yellow, light brown or chocolate brown from color of intestinal canal. Caudal cirrus slender, white. No retractor muscle to proboscis *Z. littoralis*, p. 177.

AAA. Head with deep, horizontal furrows. Proboscis of three muscular layers, outer longitudinal, circular, and inner longitudinal layers, or of the two former only; muscular crossings usually present.

- a. Caudal cirrus absent. Body long and slender, rounded or flattened; very contractile *Lineus*.

1. Slender, small, usually 10 to 15 mm. long. A single row of two to four (rarely six to eight) irregular ocelli on each antero-lateral margin of head. Pink or rosy flesh color, sometimes with tinge of blue; deep flesh color to purplish brown in intestinal region; head white *L. rubescens*, p. 179.

2. Up to 12 cm. in length; usually three to seven irregularly fragmented ocelli on each side of snout. Yellow, sometimes with decided tinge of orange, deep ochre or pale yellow *L. flavescens*, p. 184.

3. Large, soft and flabby, up to 50 cm. in length; cephalic furrows remarkably long. Ocelli wanting. Dark brown of various shades of color, velvety; a series of narrow, pale yellow rings, expanded to diamond-shaped spots on dorsal surface, usually encircle body, but may be very inconspicuous. Dorsal surface usually corrugated longitudinally with series of very delicate, inconspicuous, longitudinal yellow lines. Tip of snout white, usually with two small orange-colored spots situated in an area of pale yellow on dorsal surface.

L. pictifrons, p. 188.

4. Length 10 to 15 cm. or more; head broad; ocelli wanting. Dark brown with conspicuous median dorsal white or light yellowish stripe which expands on head to form a broad, pear-shaped marking. Usually a faint reddish line extends along each lateral margin of body *L. albolineatus*, p. 193.

5. Body rather stout, flattened in intestinal region, fragile; length up to 15 cm. or more; head long and slender, with long cephalic furrows; ocelli wanting. Brownish, dark drab or purplish brown, with a series of very fine white rings, often much obscured; tip of head and borders of cephalic furrows white.

L. wilsoni, p. 195.

- aa. Caudal cirrus present. Body rather firm, not provided with thin lateral margins in intestinal region; incapable of swimming *Micrura*.

1. Of small size, 4 to 8 cm. in length; ocelli wanting. Deep blood red, sometimes with tinge of purple; head of same color, with narrow, transverse, white crescent near tip of snout which has a small terminal black or dark brown spot surrounded by red continuous with that of ventral surface.

M. nigrirostris, p. 198.

SYSTEMATIC DISCUSSION OF NEW SPECIES

In the following pages those species recently found on the Pacific coast of North America which have proved to be new to science are described in detail from a study of both living specimens and prepared sections. Only those anatomical features are discussed, however, which offer peculiarities not found in most related species or which are of special interest from a morphological standpoint.

Included with the species new to science are certain forms which have not previously been recorded from the Pacific coast of North America. Of these only the most striking anatomical peculiarities are mentioned.

Descriptions of only those genera which were not represented in the collections described in Part I of this report are given place here. For the remaining generic descriptions the reader is referred to Part I, previous article.

1. CARINELLA FRENATA sp. nov.

Pl. xv, figs. 5, 6; Pl. xxii, figs. 2, 3.

In general shape of body this species resembles those which are most typical of the genus, as *C. superba*, *C. capistrata*, *C. sexlineata*, and which have rather firm, moderately slender bodies. Head much broader than body, rounded or emarginate in front, much flattened dorso-ventrally, sharply marked off from body by deep, lateral, trans-

verse grooves. Head commonly quite as wide as long, but shape liable to the greatest variation. Proboscis pore and mouth as in related species. The color and markings on body are very characteristic and widely different from those of any described species of the genus.

Size.—Length of body 50 cm. or more, width 2–3 mm.

Color.—General color of body grades from a yellow cream or ochre in anterior third of body to a sage green in intestinal region. When filled with ripe ova the greater portion of dorsal surface of intestinal region becomes a rosy but opaque flesh color or dull rose color. On this ground color is arranged a series of remarkably sharp, deep brown, transverse and longitudinal lines and bands. There are three longitudinal, very distinct, dark brown or black lines throughout the length of the body, except on the head. One of these lies in the dorso-median line, while the other two are symmetrically placed on, or a little beneath, the lateral margins (pl. xv, fig. 5).

The color of the markings is beautiful and has a velvety luster; in some lights it appears somewhat iridescent and sometimes shows a rich, dark blue reflection. Of the three longitudinal lines the median dorsal line is much broader than the others. It commences on the extreme tip of snout, where it joins a narrow transverse terminal line of the same color. On the head it is broader than elsewhere and occupies about one-fifth the diameter of head. It continues through the transverse bands or rings, usually expanding a little where the rings are joined. In many cases the line can be traced directly through the transverse bands by a deeper color, as if the two markings had been painted the one over the other. In the intestinal region the median line occupies perhaps one-seventh the diameter of body. The two lateral or marginal lines each commence at the broad neck band (the first transverse band).

These lateral lines are scarcely more than one-third as wide as the median line; they are very sharp and clear cut in the anterior portion of body, but become more irregular in outline in the intestinal region. They are never wholly interrupted however. They are cut more sharply ventrally than dorsally, for on their dorsal side they sometimes fade out gradually into the general color of body. Like the median line, the lateral lines broaden out somewhat where they join the transverse bands, and, as is also true of the median line, they often show corresponding thickenings in places where the transverse bands are not formed or are very imperfect. A thickening of one line is almost always accompanied by a corresponding thickening of the other two, showing clearly where the transverse band would lie if it were present.

On the anterior third of body these longitudinal lines are situated directly in the yellow ground color, but in the intestinal region the median line is separated from the rose-colored ground color of the mature females by an irregular border of sage green thickly flecked with whitish dots. This sage green color probably represents the general ground color of the worms when the sexual products are absent; while the rose color, which seems to make up the general color of the dorsal surface of intestinal region, is due to the thickly-placed sacs of ova, which are of a pale rose color. In some regions these rose-colored spots are separated by a continuous green ground color, as shown in fig. 5, pl. xv.

The transverse markings are very numerous and are of various widths from the first two bands, which are more than half as wide as the body, down to the finest possible lines. Many are extremely fine, and many others incomplete. As a rule, the wider bands are separated by one or two much finer ones, and seldom, or never, are two of the wider bands immediately adjoining. The first transverse marking borders the extreme tip of head and is narrow and barely visible both on ventral and on dorsal surface. It extends laterally from end of median longitudinal line about half way to the posterior border of head. The second transverse marking occurs on the neck just back of the lateral furrows which separate the head from the body. This marking is broad and shield-shaped on dorsal surface, but is narrower laterally, while on the ventral surface it is interrupted by the mouth, which lies exactly in the region which would be occupied by the band if it were continued. The first band is about half as wide as body. The second is separated from the first by a distance about equal to twice the diameter of body, and is a little broader than the first on the dorsal surface. It forms a continuous band around the whole body, but on ventral surface it is not much more than half as broad as on median dorsal surface. The third band is separated from the second by a distance less than that between the first and second, and is somewhat narrower than either of these. The fourth is separated from the third by a greater distance than in any other case; it is as broad as the second, and is as wide ventrally as on the dorsal surface. The fifth is very narrow, the sixth broad, seventh narrow, eighth broad. Then come two imperfect narrow bands, and then a fairly broad one, and so on, through the remainder of the body, with a broad band usually followed by one or two narrow or imperfect ones. An individual measuring 50 cm. in length shows from seventy to one hundred of these transverse bands. In general the bands decrease in width toward the

posterior end of body. Many of the broader bands show a number (three to twelve) of fine, pore-like, pale dots in midst of dark band between the median and lateral longitudinal lines. Transverse bands often broaden out as they join the longitudinal lines (pl. xv, fig. 5), but a few are interrupted just ventral to the lateral longitudinal lines.

Ventral surface anteriorly same as dorsal surface in color, but with a more conspicuous flecking of minute whitish dots. In intestinal region the yellow color gradually assumes a more greenish tone, until imperceptibly a shade of sage green, or very light olive green, is reached, and this color extends through to the end of the body. The green color is more or less tempered and obscured by an irregular coating of very fine whitish dots which cover ventral surface irregularly, except near the median line; similar white flecks are scattered over the dorsal surface also.

After preservation in formalin or in alcohol the portion of the body situated immediately posterior to the third black ring becomes deep slaty blue or blackish in color. This dark color is sharply demarcated anteriorly, but fades out gradually after extending about as far as the ninth ring (pl. xv, fig. 6).

The pale ochre color with deep black rings and longitudinal lines is retained even in cedar oil and in paraffin. The colors, markings and shape of anterior end of body after preservation are strikingly suggestive of the abdomen of the yellow-jacket wasp (*Vespa*).

Proboscis pore is situated just below anterior end of median dorsal black line. Mouth, as stated above, lies in first transverse band.

In midst of lateral, longitudinal black line, and at the anterior border of the fourth transverse band (or in it) is a rather conspicuous, colorless, oval pore, representing the lateral sense organ, or 'side organ.'

Intestinal canal is usually greenish in color — sometimes sage green.

Body often shows a tendency to become constricted through the transverse black bands, and when broken the rupture takes place in these bands, as has been noted in other species of the genus.

Cephalic glands but little developed, appearing only as scattered gland cells lying beneath and beside the rhynchodæum. No glands whatever are to be found between the cephalic blood lacunæ and the basement layer of the integument. The integumental gland cells, on the other hand, are very highly developed, and form an unusually massive layer beneath the ordinary superficial glandular and ciliated cells. The secretion of these deeper glands of the integument is apparently of the same nature as that of the true cephalic glands, which in all probability serve merely to supplement the supply furnished by the in-

tegument. The few glands about the rhynchodæum do not extend back as far as the brain.

Integument of body remarkably thick and closely packed with glands. In the intestinal region the glands are vastly more abundant on the dorsal than on the ventral surface. It is in this layer that the pigment which gives the body its characteristic transverse and longitudinal dark markings is situated. Unless stained too deeply the position of the markings is distinctly seen in each transverse section.

Proboscis.—Of small size, yellowish or ochre in color. Muscular and epithelial layers as in other species of genus; fibrous layer, situated externally, unusually strong; proboscis nerves, beneath internal epithe-

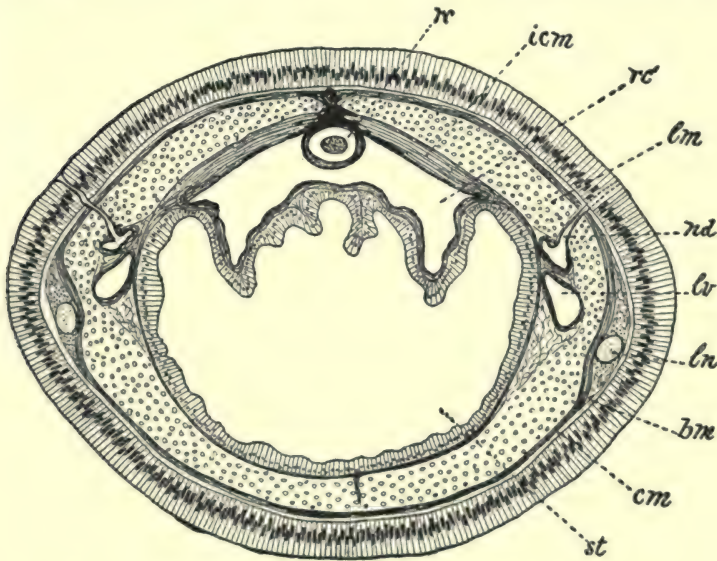


FIG. 17. *C. frenata*. Transverse section of body in region of nephridiopores. $\times 25$.

lium, remarkably large and conspicuous. Proboscis sheath well developed. In the exact region of the efferent nephridial ducts the cavity of the proboscis sheath becomes divided. A very small chamber, situated dorsally (text-fig. 17, *rc*), passes backward for some distance, and in this the retractor muscle of the proboscis extends to the posterior attachment; while the ventral chamber (*rc'*), which is very much the larger, passes backward but for a short distance where it ends in a broad, blind sac. The retractor muscle is attached to the dorsal wall of the smaller dorsal chamber a little distance back in the intestinal region, and

the proboscis sheath itself does not extend backward behind the anterior third of the intestinal region.

Body musculature consists of the usual circular and longitudinal layers, and presents few peculiarities save that the inner circular layer, which is found in the esophageal region, is remarkably thin, and does not exhibit distinct dorsal or ventral crossings with the outer circular layer, as is the case in several other species of the genus. Immediately in front of the nephridial openings the inner circular layer becomes several times as thick as it is anteriorly, while it disappears almost entirely just at the beginning of the intestinal region. The circular muscles of the proboscis sheath present a similar increase in strength in the same region, and are directly continuous with the inner circular muscles of the body wall (text-fig. 17, *icm*). These thickenings correspond in nature and position with the enormously thickened internal circular muscles in *Carinoma*.

Blood System.—Lacunæ in head and lateral vessels present no peculiarities. The pair of vessels situated within the proboscis sheath originate anteriorly just behind the mouth and extend back nearly half way to the intestinal region, being connected with the lateral vessels at frequent intervals. Their walls are thickened, much convoluted, and appear to be somewhat glandular in nature.

Nephridia.—The nephridial tubules are limited to about the third quarter of the esophageal region. They do not extend forward quite as far as the posterior ends of the proboscis sheath vessels. Their anterior branches are numerous, but of small size. They project inward from the lateral walls of the lateral blood vessels, very much as in *Carinoma*. The main longitudinal canals are large, and are situated in the parenchyma above the lateral vessels, and slightly separated from them. There is a single main longitudinal canal on each side, and this is usually about half the diameter of the lateral vessel in the same region. At its posterior end each of the longitudinal canals enlarges somewhat, and as usual sends off a large efferent duct (*nd*, text-fig. 17) to the dorso-lateral aspect of the body.

Nervous System and Sense Organs.—The cerebral sense organs are well developed for the genus, although they are not distinctly separated from the other nervous tissues, as in the case of *C. rubra*.¹ Yet there is a distinct ciliated canal leading from a specialized lateral furrow into the nervous tissues above and beside the dorsal brain lobe. The inner end of this ciliated canal (Pl. XXII, fig. 2, *cc*) passes within

¹ Coe, Proc. Wash. Acad. Sci., III, p. 13, Pl. X, fig. 2, 1901; also previous article, pagged identically.

the basement membrane and outer fibrous layer, and is thus well removed from the integument. Here it lies in close contact with the dorsal surface of the brain, and is closely surrounded by large nerves (pl. XXII, fig. 2, *sn*) from the dorsal ganglia. Externally it terminates on a slight papilla in the middle of the distinct, though short, lateral groove with which the side of the head is provided. The epithelium of the groove is also unquestionably sensory in its nature, and lies in close proximity to the brain, from which it is supplied with numerous small nerves.

The lateral sense organs, or side-organs, are situated immediately behind the efferent nephridial ducts, as in other species. They are rather conspicuous in life, when they appear as colorless oval spaces in the midst of the lateral longitudinal black lines, and at the anterior border of the fourth transverse band. They are not very extensive, but possess a remarkable degree of specialization. The sensory cells are less than half as high as the neighboring cells of the integument, so that each of these sense organs appears as a conspicuous oval depression exactly on the lateral margin. The cells, too, are rendered still more conspicuous from the fact that the secretions situated deep among the cells assume a deep blue stain with hæmatoxylin and orange, while the integumental cells always take on more or less of the orange color, and are partially obscured by the dark body pigment. The relation of the sense organ to the other tissues is shown in pl. XXII, fig. 3.

The brain and lateral nerves present no striking peculiarities. There are two dorso-median nerves as in several other species of the genus. The upper nerve lies in the median line, just external to the outer circular muscular layer, while the lower, or inner, lies directly beneath the former and just outside the inner circular muscular layer.

Reproductive Organs.—Sexual products are mature in August. The eggs are opaque and rose-colored, and give the characteristic rose coloring to the bodies of the females at this season. They develop in pouches in the parenchyma above the lateral nerves, and each pouch, containing from 20 to 50 or more ova, opens directly to the dorso-lateral surface of body. The oviducts are completely formed in advance of the deposition of the eggs, and are in all cases lined with a distinct layer of small, closely placed epithelial cells. Even before the eggs are fully mature the small pouches in which the ova of the following year are to develop are already established. Several ovarian pouches are encountered in each transverse section.

Habitat.—Several feet below low-water mark on piles of wharf, San Pedro Harbor, Calif.; not common. Only sexually mature females were obtained.

2. *CARINELLA ALBOCINCTA* sp. nov.

Pl. xvi, figs. 4, 5.

Body rather stout for genus, but can become much more elongated than the figures indicate; not much flattened, rather firm, less soft than in *C. rubra* or *C. frenata*. Head of moderate size, of variable shape, broader than neck, from which it is demarcated by an annular constriction. When body is strongly contracted, however, the anterior portions become much swollen and wrinkled, and the head withdrawn into the body until it is partially hidden from view from above. A pair of very shallow transverse grooves lie on the lateral margins of head, just in front of neck. Esophageal region rounded, intestinal region not much flattened, posterior extremity not slender.

Proboscis pore subterminal; proboscis rather small. Mouth situated just back of annular constriction marking the neck, of variable size according to state of contraction of body.

Color.—General color of body usually a beautiful cherry red, sometimes inclining to brick red, and sometimes to purplish red, with a series of narrow, pure white rings. These rings are all very narrow, hardly thicker than a thread, though some are much finer than others and are merely indicated as very delicate hair lines. They are placed at varying intervals throughout the length of the worm, and most of them completely encircle the body. There may be 50–100, or more, in a large individual.

Tip of snout provided with a narrow, terminal border of white, which reaches back along the lateral margins of head for a little distance. This terminal white border extends to ventral surface, where it is fully as conspicuous as from above. When head is extended and obtusely pointed the white marking is angular, and extends back on the lateral margins for about half the length of the head. In the angle of the marking, on the ventral surface, lies the proboscis pore. When head is contracted strongly the terminal white border appears merely as a short transverse marking on each side of the proboscis pore.

The first white ring lies on the constricted neck portion, and is interrupted by the mouth (Pl. xvi, fig. 5), so that it is incomplete ventrally. The second ring is commonly separated from the first by two to three times the width of the body. This ring is short and complete, but is thinner ventrally than on the dorsal surface. The third ring is about half as far behind the second as the latter is from the first. Then

follows a long series of similar rings separated from each other by an average distance of a little less than the diameter of body in moderate extension. Of course the separation of the rings depends largely on the state of contraction of body, for when strongly contracted they are less than a quarter as far apart as when extended. Nearly all the rings are complete, but many are thinner ventrally than above. Some are extremely fine, and others consist of double lines separated by a very thin line of the red color of body.

The general color of body becomes gradually lighter in intestinal region, which often has a slightly yellowish tinge. Ventral surface is of a lighter shade than dorsal, and has a grayish tinge.

After preservation in formalin or in alcohol the body assumes a dull reddish brown or purplish color, with very faint white rings. An abrupt change in color usually occurs at the second white ring, the parts anteriorly commonly being brownish, while those immediately behind the ring are often deep purple. The white terminal border on the head remains conspicuous when the worm is not strongly contracted.

Size.—Largest specimen observed was about 30 cm. long and 4 mm. in width, although others were less than half this size.

In internal anatomy the species presents few deviations from that described for related species of the genus.

Proboscis of rather large size for genus, with muscular layers and pair of large nerves as in other species.

Musculature.—Fibrous crossings between the external and internal muscular layers of the body walls are but little developed.

Cephalic glands are voluminous, and occupy a great portion of the tissues of the head in front of the brain.

Alimentary canal presents no striking peculiarities.

Blood System.—Cephalic blood lacunæ of large size. Their branches pass posteriorly as large lateral vessels, or lacunæ, which send off unusually numerous branches about the esophagus. These esophageal lacunæ pass ventrally well beneath the esophagus, and exhibit abundant anastomoses as in some species of *Cerebratulus*.¹ The rhynchocœl vessels originate some distance behind the mouth region, though not as far posteriorly as in *C. cingulata* (p. 141). As in the latter species, these vessels are short and of much less extent than in many related forms.

Nephridia.—The excretory tubules are limited to about the third and fourth fifths of the esophageal region. Anteriorly there are several canals which branch profusely among the lateral and esophageal blood

¹ Notably *C. lacteus*; Coe, Trans. Connecticut Acad. Sci., ix, p. 493, 1895.

vessels. Farther back these branches unite into about five to eight longitudinal canals on each side, which lie above the lateral blood lacunæ and do not join until they are near the efferent ducts. Here they unite to form a rather large lacuna, as in *C. cingulata*, from the dorsal wall of which the efferent duct leads to the dorso-lateral aspect of the body.

Nervous System and Sense Organs.—Brain and lateral nerves as in other species. Cephalic nerves numerous and of large size. Median dorsal nerve small. Cerebral and lateral sense organs are less well developed than in the other species described from the Pacific coast.

Habitat.—Rather common in 50–100 fathoms between San Pedro and Catalina Island, Calif. The worms live among red algæ, having almost exactly the same color, so that they are not easily discovered among the contents of the trawl. They are found associated with *Taniosoma punnetti* and exhibit a similar tenacity of life.

3. CARINELLA CINGULATA sp. nov.

Pl. XIV, figs. 2–4.

Body long, slender, subcylindrical, resembling *C. superba* in general appearance, and not strikingly different from *C. sexlineata* and *C. capistrata*, which are also found on the California coast. In general color of body, as well as in being furnished with narrow longitudinal and transverse white markings, there is considerable resemblance. The markings on body, however, are arranged in a very characteristic manner, and differ from those of any known species.

The head is considerably broader than neck, rounded, truncate or emarginate in front, flattened dorso-ventrally. It is marked off from body by a distinct annular constriction.

Body often shows constrictions in the annular white lines described below. Proboscis pore subterminal. Mouth large, situated on the constricted portion spoken of as the neck.

Length 15 cm. or more; width about 3–4 mm.

Color.—General tone of body is deep brown, varying sometimes to chocolate and sometimes to cinnamon brown. When filled with ripe genital products the general effect of the intestinal region is only pale brownish. Head much paler than body in color, with two narrow, transverse, terminal, dark markings—one on either side of the tip of the snout (Pl. XIV, figs. 2–4). In certain states of contraction, these markings almost meet just dorsally to the proboscis pore.

On the neck is a darker brown transverse marking about one-fourth as wide as diameter of body dorsally, but which becomes narrower

laterally. Below the lateral margin it is quite narrow, and continues ventrally as a thin line which joins the one from the other side just at the posterior border of the mouth. This dark nuchal band is bordered posteriorly by a distinct white band of about the same diameter (Pl. XIV, figs. 2-4).

On the ground color of the body are four longitudinal white bands, extending with more or less distinctness throughout the length of the body. These are situated symmetrically, two very near the lateral margins of body, and the other two dividing the dorsal surface into three equal parts. The lines all terminate anteriorly in the first white ring, situated just behind the dark nuchal band mentioned above. Anteriorly the lines are narrow, but on the approach to the intestinal region, broaden out very irregularly. Those on the dorsal surface encroach so greatly on the general brown ground color as to limit it to a narrow, brown, median dorsal stripe, and two other narrow brown stripes on lateral margins. The two lateral lines come to lie ventrally to the lateral margins, and become so wide as to occupy almost the whole ventral surface—the brown color being largely replaced by the brownish white of the longitudinal bands. This may be true of the worms only at the time when the sexual products are mature, for the pouches of reproductive elements are light in color and partially obscure the brown color of body. At other seasons the white lines would doubtless appear narrower, and the brown color of intestinal region would be more pronounced.

The body is divided transversely into unequal segments by a series of narrow white rings, situated at irregular intervals from the head to the posterior end of the body, as in *C. superba*. Most of these white rings are very narrow, but are rendered more conspicuous by being bordered, sometimes on both sides, and sometimes only on one, by fine brown rings which are continuous with the general ground color, but of a darker hue. These brown rings are often more conspicuous than the narrow white ring beside them, so that some of the annular markings appear dark, rather than lighter in color (Pl. XIV, figs. 2-4). The brown rings pass through and interrupt the longitudinal pale bands. The color of the white markings, especially the longitudinal ones, appears to be superficial and applied in small, confluent spots, and not homogeneously.

The segment included between the first and second and that between the second and third white rings are each fully twice as great as any other segments. The rings are otherwise fairly regular in position, but are often interrupted or wanting on ventral surface. Prof. C. B. Wilson,

to whom I am indebted for specimens of this and other species of California nemerteans, states in his notes that "in some specimens the alternate white rings extend only to the lateral white longitudinal lines, and do not go entirely around the body."

After preservation in formalin, the region between the second and third white rings is much darker in color, as commonly occurs in the genus. As usual the contrast in color is very marked anteriorly, but shades off gradually beyond the third white ring.

A rather conspicuous rounded pit, of much paler color, situated exactly on the lateral margin of the body just dorsal to the longitudinal white band, and on the anterior border of the third white ring, marks the position of the lateral sense organ on each side.

The worms are prone to break up when captured, the fragmentation taking place at the white rings, where the body often shows constrictions.

Proboscis.—Proboscis sheath extends only a comparatively short distance into intestinal region, but is well developed throughout the esophageal region. Just in the vicinity of the nephridiopores the rhynchocoel becomes sharply divided into a smaller posterior cavity and an enlarged anterior chamber. The anterior chamber continues ventrally for a few sections as a blind sack beneath the smaller dorsal cavity into which the posterior end of the proboscis continues. These features are similar to those described for *C. frenata* (p. 133), but are less pronounced. Proboscis becomes separated from its sheath in the region of the mouth, and therefore some little distance behind the brain. It is provided with two large nerves which arise from the ventral ganglia at points of origin of the unusually large ventral commissure. The nerves pass dorsally and immediately enter the proboscis sheath, in the tissues of which they extend posteriorly for a few sections, when they enter the proboscis at its attachment to the sheath. The arrangement of the epithelial and muscular layers is as in related species.

Musculature and integument present no marked peculiarities. The basement layer beneath the integument is unusually well developed. Dorsal crossing of fibers between the internal and external muscular layers is much better developed than in any of the other known species from the Pacific coast.

Cephalic Glands.—In addition to the highly developed, deep-staining masses of glands in the integument of the head, a thick layer of similar glands is found around the rhynchodæum. These extend backward nearly to the brain, and are very conspicuous from their secretions, which stain deep purple in hæmatoxylin. The condition

in this species is intermediate between that described above for *C. frenata*, where these glands occur in the integument only, and *C. rubra*,¹ where they occur not only in the integument and around the rhynchodæum, but are thickly massed in the cephalic musculature as well.

Blood and Nephridial Systems.—Cephalic blood lacunæ and lateral vessels as in other species. Rhynchocœl vessels peculiar in that they do not appear in the anterior fourth of the esophageal region, and extend for only a short distance, terminating posteriorly in front of the anterior end of the nephridial system. During their short extent, however, they show numerous connections with the lateral vessels. The nephridia are of the normal type for the genus, with a main canal above the lateral blood vessel on each side. Anteriorly the canal branches out on the wall of the blood vessel as usual. The nephridia are of very limited extent, and occupy less than the middle third of the esophageal region. Posteriorly each of the main canals exhibits a sac-like enlargement, with highly columnar epithelium, from the dorsal wall of which the efferent duct leads to a dorso-lateral aspect of the body as usual. The efferent duct is not an open tubule, however, but spreads out in the external circular muscular layer into a broad, spongy meshwork, from which a small duct leads to the surface.

Nervous System.—Ventral commissure of brain even more massive than in most related species. Large and numerous cephalic nerves extend throughout the tissues of the head. Dorsal and buccal nerves are also of large size.

Cerebral Sense Organs.—Much less highly differentiated than in any other species of the genus yet described from the region. Ciliated canals wanting, the sense organ consisting simply of an oval area with differentiated sensory cells of smaller size and with longer cilia than elsewhere, and provided with a rather large nerve from the dorsal ganglion which lies adjacent, and just beneath the well-developed basement layer. The region is always conspicuous by the absence of the deeply staining glands which are found elsewhere on the body. Thus the cerebral sense organs differ but slightly in their histological features from the lateral sense organs found in the vicinity of the nephridiopores.

Lateral Sense Organs.—Small, but very sharply defined. They are situated on the lateral margins of the body immediately posterior to the nephridiopores. The sensory epithelium is made up of slender

¹Coe, Proc. Wash. Acad. Sci., III, p. 14, pl. IX, fig. 1, 1901; also previous article, paged identically.

cells, which present a sharp contrast to the neighboring cells of the integument because of their comparative freedom from secretion. The general appearance of the sense organ is similar to that figured for *C. frenata* (Pl. XXII, fig. 2).

Reproductive Organs.—Sexual products mature in September. Sexual pouches are usually situated dorsally to the lateral blood vessel, and open on the dorsal aspect of the body.

Habitat.—Monterey Bay, Calif. Shallow water; not common. Dredged from soft bottom in fourteen fathoms off McAbee's Beach, Monterey Bay, Calif., by C. B. Wilson, 1899.

Nemertopsis Bürger

Fauna and Flora des Golfes von Neapel, Monogr. 22, p. 548, 1895.

Representatives of this genus are characterized by extremely long thread-like bodies of firm consistency. They resemble *Emplectonema* in form, habits and general internal anatomy, but differ in having only four ocelli, which are symmetrically placed on the head, in armature of proboscis, and in other anatomical details.

The worms are quite as slender as those of the genus *Cephalothrix*, but they do not coil the body in a spiral.

Proboscis sheath very short, proboscis armed with well-developed central stylet and basis, and with two pouches of accessory stylets; cerebral sense organs small, situated well in front of brain. Cephalic glands usually well developed.

But two species of this genus have thus far been described, both of which have been found in the Mediterranean. A third form, described below, occurs on the Pacific coast of North America.

4. NEMERTOPSIS GRACILIS sp. nov.

Pl. xv, fig. 1; Pl. xx, figs. 10, 11.

This very slender species bears a close external resemblance in form and color to *N. peronea* (Quatr.) Bürger, but differs in several features of internal organization, especially in the structure of the proboscis armature and the extent of the intestinal cæcum.

Like *N. peronea* the body is extremely long and slender, probably more so than any other Nemertean found on the coast except species of *Cephalothrix*. The body is commonly 10 to 15 cm. or more in length, and usually less than 1 mm. in breadth. The head is slightly broader than the body, which is somewhat flattened dorso-ventrally, but of nearly equal width throughout its length. Mouth and proboscis have a common opening.

Color.—The color of the dorsal surface of the body is dull whitish with a tinge of brown, or sometimes decidedly brownish, with two narrow longitudinal bands of deep brown extending throughout the length of the body. Each of these brown bands is perhaps one-eighth as broad as the body. They lie near the median dorsal line, and are separated from each other by about twice the width of either band. On the head they lie just internal to the eyes, and do not extend quite to the tip of the snout (Pl. xv, fig. 1). They are sharply marked off from the much paler color between them, but show a tendency to shade off laterally into the general pale brownish color of the dorsal surface. Towards the lateral margins the brownish tinge becomes very inconspicuous and gradually shades off into the whitish or pale flesh color which covers the ventral surface.

Ocelli.—Four eyes of large size are arranged, as in *N. peronea*, to form the corners of a square (Pl. xv, fig. 1).

Cephalic Glands.—Enormously developed cephalic glands occupy the greater portion of the head and stretch far back into body, extending even as far back as the most anterior sexual pouches. In the esophageal region these glands often occupy more space than the proboscis sheath and esophagus together, and fill up the space usually taken by the body parenchyma, which is in this species very much more reduced than in *N. peronea*.

Proboscis.—The proboscis sheath is not much more than one-third as long as the body. The proboscis is provided with eight large nerves which reach back to the stylet apparatus; the muscular and epithelial layers are as in *Amphiporus*. Central stylet of proboscis slender, provided with an elongated, slender basis, measuring (in a single specimen) about 0.123 mm. in length by 0.02 mm. in average diameter.¹ The basis is peculiar in being of nearly the same diameter throughout (Pl. xx, figs. 10, 11), and not swollen posteriorly. The shape of the basis alone will readily serve to distinguish the present species from *N. peronea*, which has a short conical basis. The central stylet is rather slender, but my notes unfortunately do not indicate its dimensions, nor whether it is shorter or longer than the basis. Each of the two lateral pouches contains usually from four to six slender stylets. In the preserved specimens there is no evidence that the stylets have their heads lobed or five-parted as do those of *N. peronea*.

Alimentary Canal.—The intestinal cæcum, which lies in the median line directly beneath the esophagus, is very short indeed and is

¹ But a single basis was measured, so that these dimensions may not represent average measurements.

without branches. It is much shorter than in *N. peronea* and is separated from the brain by several times its length, while in *N. peronea* it is described by Bürger (*loc. cit.*, p. 549) as reaching nearly to the brain. In one series of sections of *N. gracilis* the cæcum itself extended through seventeen sections only, while there were about seventy-five sections between its anterior end and the brain.

Nervous System and Sense Organs.—Brain and nervous system present no important deviations from those of *N. peronea*. Cerebral sense organs small, much elongated, situated far in front of brain and connected with exterior as usual.

The sexual products ripen late in summer. The ovaries and spermaries lie directly above the lateral nerve cords, but when fully developed extend also internal to them.

Habitat.—Pacific Grove, Calif., among mussels and other growths on rocks at low water. Not common. Collected in same locality in 1899 by C. B. Wilson.

Paranemertes Coe

Proc. Wash. Acad. Sci., III, p. 32, 1901.

Three species (*P. carnea*, *P. peregrina*, *P. pallida*) of this genus have been described from Alaska (*loc. cit.*).¹ A fourth species was found abundantly at San Pedro and San Diego, California. This form agrees with those previously described in general anatomical features, but differs in regard to the number and arrangement of the ocelli, so that the part of the generic diagnosis which refers to the ocelli (p. 32) will have to be amended to read, "Ocelli minute, usually numerous, but sometimes consisting of but a single pair."

5. PARANEMERTES CALIFORNICA sp. nov.

Pl. xv, fig. 2; Pl. xviii, figs. 1-5; Pl. xxi, figs. 1-9.

Body long, moderately slender, rounded or cylindrical in the short esophageal region, very much flattened farther back. Intestinal region much wrinkled when contracted, but smooth when body is well extended. Head small and acutely pointed in ordinary states of contraction. The snout, with the ocelli, can be retracted to a very considerable extent into the tissues of the head, very much as in some species of *Taniosoma*. Intestinal region flat and ribbon-like with thin margins which are sometimes bent towards the ventral surface. Posterior extremity rounded.

¹ Also previous article, identically paged. The peculiar fluted or braided appearance of the stylets (both central and accessory) of *P. peregrina* was not described in the previous article but is represented on Pl. xx, figs. 14, 15.

Size.—Length of largest specimen obtained 45 cm.; width 4–6 mm.; usual length 10–20 cm.

Color.—The colors are far less opaque than in most species, and are of such a nature as to give the tissues a remarkably translucent appearance. Anterior portion of body pale orange inclining to flesh color, sometimes more decidedly orange and sometimes pale flesh color. Head distinctly orange, but usually of a pale tint. Brain region a little more reddish in color. General color of intestinal region grayish flesh color, or very pale salmon, and somewhat translucent, but this ground color is so much obscured by the dark green color of the intestinal tract that in effect this region appears of a greenish tinge. Commonly the green color extends as a pair of broad, irregular longitudinal bands separated by a pale reddish median band (where the intestinal lobes do not show), and bordered on the lateral margins by pale, grayish salmon or occasionally by whitish.

The ventral surface is somewhat paler than the dorsal, and the median reddish band is replaced by the greenish color of the intestine.

On the dorsal surface near the anterior end of the body are two regions of slightly differentiated color, the one reaching back in the median line nearly to the brain, the other extending about as far posteriorly behind the brain as is this organ from the tip of the snout. These show simply as regions of more orange color, and the posterior region is separated from the flesh colored portion behind by a V-shaped, orange colored groove. The apex of the groove lies in the median line and points posteriorly, while its limbs extend obliquely antero-laterally to the ventral surface where they come nearly into contact in the median line. A similar, but very indistinct, V-shaped groove lies just posterior to the anterior orange colored region.

On the under side of the head is a pale area on the tip of the snout marked off posteriorly by an orange colored line from the still paler triangular area found on each lateral side of the head.

About 10–15 mm. back of the head (in an individual about 20 cm. long) darker areas appear on the sides of the body and increase in number back to the intestinal region. These indicate the pouches of the intestinal cæca which stretch forward far into the esophageal region, and which in the intestinal region are dark green in color. This color is very permanent and remains after preservation in formalin or in alcohol, and even after imbedding in paraffin. The green intestinal lobes nearly all fork distally, and each fork is again divided, but there is much irregularity in this respect.

The median dorsal band of pale reddish color is due to the color of

the fluid in the proboscis sheath. This is not very conspicuous in the esophageal region, where the proboscis fills most of the space in its sheath, but in the intestinal region the proboscis sheath is seen to be filled with a clear red fluid. The red color does not reside in the corpuscles, but exists in the fluid itself, while the corpuscles are nearly colorless. Occasionally an individual has the intestinal region grayish in color, and in such cases the proboscis sheath is very conspicuous as a wavy longitudinal, blood-red band about one-fourth the diameter of the body.

After preservation the esophageal region becomes almost colorless, but the intestinal tract gives a decidedly greenish color to the rest of the body.

Proboscis.—When extruded the proboscis appears of a reddish color due to the red rhynchocœl fluid within it, but when this fluid is pressed out the proboscis remains colorless. It is of fairly large size, and is provided with four or six pouches of accessory stylets in addition to the central stylet (Pl. XVIII, fig. 2; Pl. XXI, fig. 3). The basis of the latter is rather long and slender, slightly narrower anteriorly, but of fairly even diameter throughout (Pl. XVIII, figs. 4, 5; Pl. XXI, figs. 4-8). The stylet itself is moderately slender and about half as long as the basis, or sometimes a little more than half as long. There are usually two or three accessory stylets in each of the four or six pouches. All the stylets, both central and accessory, show a peculiar darker or more opaque portion about the head (Pl. XXI, figs. 4-9). This darker portion extends perhaps one-sixth the length of the stylet. Measurements in a single specimen are: Basis of central stylet 0.36 mm. long, 0.1 in average width; stylets about 0.17-0.2 mm. in length.

In each of three specimens sectioned the proboscis was provided with ten large and distinct nerves. A fourth individual showed an abnormal condition in that there were twelve distinct nerves in a short region of the proboscis, although there was but the usual number (ten) both anteriorly and posteriorly to this region. A fifth specimen showed eleven nerves. The nerves are often one-half to three-fourths as great in diameter as the thickness of the longitudinal muscular layer. Muscular and epithelial layers as usual, but the basement layer beneath the internal epithelium is so very much thickened that it practically equals the circular muscular layer in thickness.

Proboscis sheath reaches fully one-half the entire length of the body, but does not extend into the posterior one-third of the animal. In this respect the present species agrees well with the other members of the genus from Alaska. Muscular layers of proboscis sheath enor-

mously developed as far posteriorly as the anterior portion of the intestinal region. In few other Hoplonemerteans is the proboscis sheath so powerful as in the present species (Pl. XVIII, fig. 1).

Ocelli.—The snout when well extended is sharply pointed, but can be withdrawn to a considerable extent into the tissues of the head. For this reason the two very small ocelli which are situated near the tip of the snout (Pl. XXI, fig. 1) are likely to be overlooked, and are difficult to see in the living worm. They lie deep in the tissues of the head and can usually be seen clearly only after the specimen has been cleared in cedar oil or some other suitable medium. Sometimes instead of two single ocelli, we find two groups each made up of two or more minute pigment spots (Pl. XXI, fig. 2).

Cerebral Sense Organs.—These are extremely small, measuring scarcely more than one-tenth the diameter of head in same region, lie some distance in front of brain, and connect with exterior on latero-ventral margin of head near tip of snout.

Cephalic glands are voluminous, composing the greater portion of the tissues of the head in front of brain. They are much interspersed with connective tissue and muscle fibers, and do not extend posteriorly to the brain in any considerable numbers. There are a few isolated *submuscular glands* in the esophageal region.

Brain small as compared with the diameter of head, but of the usual proportions.

Muscular System.—Just in front of brain, and in the region of the attachment of proboscis to its sheath, a longitudinal muscular layer arises quite independently and is distinct from the longitudinal muscles of the body walls. These muscles surround the brain, esophagus, and proboscis sheath. This secondary longitudinal muscular layer increases greatly in size back of brain, but remains separated from the musculature of the body walls by a thick layer of parenchyma. Back of the brain this muscular layer (*lm'*, Pl. XVIII, fig. 1) becomes thicker than the main longitudinal layer (*lm*) of the body walls, and its fibers are larger, more closely placed in their bundles and stain more deeply. It reaches a considerable distance into the esophageal region, but gradually the bundles comprising it become more and more separated from each other by parenchymatous tissue, and gradually they approach nearer the body walls. Some of the fibers attach themselves to the proboscis sheath just outside the circular muscular layer. Eventually they become arranged just internal to the longitudinal muscles of body walls and form a portion of this layer. Their fibers are much larger, however, and by an increase in number farther back give rise to the

main portion of the longitudinal muscles of body walls. In no other species, so far as I am aware, has any such condition been described, though an approach to it is met with in *A. nebulosus*,¹ where the submuscular glands develop to such an extent as to form a distinct layer which divides the longitudinal muscular layer into an outer and an inner portion.

An unusual amount of parenchyma surrounds the muscles, nerves, proboscis sheath, esophagus and other organs.

Alimentary Canal.—Especially remarkable is the short extent of esophagus, which separates from rhynchodæum just in front of brain, and enlarges posterior to this organ, as usual. Instead of extending far posteriorly, however, as in most related species, it is only about twice as long as the distance from tip of snout to brain. It then enters the dorsal wall of the intestine, the anterior portion of which in this case corresponds in position and histological structure to the intestinal cæcum of other forms, although it does not end blindly. An extremely short cæcum proper is, however, present and extends forward, with a few pairs of lateral lobes, for a very short distance anterior to the posterior opening of esophagus.

The portion of the canal posterior to the esophagus which corresponds to the cæcum of other forms extends backward for a long distance before merging into the intestine proper. This condition has evidently arisen from the disappearance of the long, slender pylorus of the typical Hoplonemertean, so that the esophagus opens very near the anterior end of the long cæcum, instead of far back, as in most other members of the order. I shall therefore refer to the cæcum all that portion of the alimentary canal which lies anterior to the intestine proper and exhibits lateral diverticula. This will include the short cæcum proper, together with the intestinal canal back as far as the intestine proper.

The character of the epithelial lining of esophagus agrees with that in related species. Where the esophagus enters dorsal wall of cæcum, however, a marked change in the character of its epithelium appears, as in other forms. Both the cæcum and the cæcum proper have the same anatomical and histological peculiarities. Both send off paired lateral diverticula, which are closely placed together, of rather small size (Pl. XVIII, fig. 3), and extend laterally somewhat above the lateral nerves.

The histological structure of the cæcum is as in related species,

¹Coe, Proc. Wash. Acad. Sci., III, p. 49, Pl. XI, fig. 1, 1901; also previous article, paged identically.

except that the cells in the lateral diverticula are provided with a peculiar granular pigment which gives them a deep green color. The same pigment occurs in the intestine proper, and is conspicuous in life, giving the body a large portion of its characteristic coloring. It is insoluble in alcohol, cedar oil, or the mounting media, and is far more conspicuous in preserved specimens after they have been placed in clearing oil. In the cæcum the pigment is limited to the lateral diverticula, and is not found in the central canal.

Toward the posterior end of the cæcum the diverticula become longer and the canal gradually takes on the character of the intestine proper near the most anterior sexual glands. The intestinal diverticula are very closely placed, and for the most part fork once or twice into two or four similar branches. These are very conspicuous in life or after clearing in oil, because of their deep green pigment, as stated above. Other than in the presence of this peculiar pigment the histological structure of intestine is as in related forms.

Blood and Nephridial Systems.—In the head, as well as posterior to the brain, the blood vessels branch out into very numerous branches, which ramify through the parenchyma, including both that which lies internal to the inner longitudinal muscles and that between the two longitudinal muscular layers which are described above. The vessels are all of small size, and extend on all sides above proboscis sheath and beneath esophagus, as well as laterally. Back toward the intestinal region they form the usual pair of lateral vessels. The proboscis sheath vessel is as in related species.

In regard to the nephridia, it is necessary to state that no well-developed nephridial tubules were found, although several series of sections were examined carefully back as far as the anterior sexual glands. A number of very fine tubules in the esophageal region may possibly represent the nephridial system, although they were scarcely to be distinguished from blood vessels. There were some indications that these tubules were connected with several very minute efferent ducts opening to the surface laterally, but this could not be demonstrated with certainty in any case.

Reproductive Organs.—Sexual products had evidently been recently discharged from individuals collected near the end of July. The ducts, which still remained open, connected with the dorso-lateral surfaces of the body.

Habitat.—Individuals of this species are rather common in sand at low water in San Diego Harbor. They were also obtained from sandy locations on Dead Mans Island, San Pedro. A single specimen

was collected on a pile of wharf in San Diego Harbor. When handled the worms exude an abundance of a milky mucus.

Carcinonemertes Coe

American Naturalist, xxxvi, p. 440, 1902.

Parasitic Nemerteans living on various species of Crustacea. Body small, slender, often filiform, rounded, and of about the same diameter throughout; head without distinct lateral grooves, not demarcated from body. Body not usually coiled or much twisted, but often folded sharply, so that anterior portion of body lies parallel and in contact with posterior portion. Mouth and proboscis open together; esophagus extremely short, opening broadly into intestine through a large muscular chamber situated immediately behind brain; intestine broad, with short lateral pouches which are but little developed in posterior portion of body.

Proboscis.—Proboscis sheath without muscular walls, consisting merely of a thin membrane closely applied to the small proboscis. Proboscis but little developed, very small in size, and extremely short, without lateral pouches of reserve stylets, but armed with central stylet and basis only. Central stylet minute, basis small and slender. Stylet region of proboscis can be withdrawn but little behind brain; consequently anterior chamber is very short, without distinct muscular layers, without distinct nerves, and without a thickened glandular epithelium such as occurs in almost all other Nemerteans. Chamber immediately behind stylet small but muscular, and with a lining of flattened epithelium, while posterior proboscidal cavity is very short, often almost spherical, highly glandular, connected closely with the rudiments of the proboscis sheath and embedded in the connective tissue which lies internal to the body musculature.

Ocelli two. *Cerebral sense organs* probably wanting.

Cephalic glands massively developed; a remarkable development of submuscular glands extends throughout whole length of body, usually forming a distinct layer internal to the muscular walls of body, and often thicker than all other layers of body wall combined.

Body musculature consists of a thin, oblique or circular muscular layer and a somewhat thicker, but yet weak, longitudinal layer internal to the former.

Usually oviparous, though fertilization often takes place internally, and sometimes a portion of the ova of an individual may be retained in the body until after the development of free-swimming embryos. Development without complicated metamorphosis.

6. CARCINONEMERTES EPIALTI Coe.

Pl. XIX, figs. 1-9.

American Naturalist, xxxvi, p. 442, 1902.

Body small, rounded, slender, of same diameter throughout; sexually mature individuals about 4-6 mm. in length and less than 0.5 mm. in diameter; head not demarcated from body; lateral grooves and cerebral sense organs very inconspicuous or wanting.

Color.—Bright orange, sometimes inclining more to reddish and sometimes to yellowish. Head a little paler, for the color is largely due to the intestinal lobes which extend forward to brain.

Ocelli.—A pair of ocelli of irregular outline, but sometimes crescent-shaped, lie about half way between tip of snout and brain. Sometimes the ocelli are irregularly fragmented, and the pigment is arranged in four irregular masses.

Proboscis.—Proboscis sheath greatly reduced, extending but little posteriorly to brain, where it becomes united with posterior chamber of proboscis (Pl. XIX, fig. 2). The sheath consists merely of few fibers of connective tissue supporting a very thin flattened epithelium, and can be seen only in favorable preparations.

Proboscis very minute and short, extending scarcely more than its own diameter posteriorly to brain (Pl. XIX, fig. 5). Rhynchodæum (fig. 5, *r*) slender; esophagus separates from proboscis cavity just in front of brain (fig. 5). Anterior chamber of proboscis (figs. 2, 3, *ac*) very small, not as long as the diameter of a brain lobe, lined with thin, scarcely glandular epithelium. Stylet region swollen (figs. 2-4) and provided with large and abundant gland cells (*g*) which open both into anterior chamber and into the narrow canal connecting this with cavity behind stylet region.

Basis of central stylet slender, about three to five times as long as broad (figs. 3-5), measuring about .027-.033 mm. in length and .005-.008 mm. in diameter. Basis slightly larger posteriorly than near attachment of the very minute stylet (figs. 2, 6). There is no trace of accessory stylets.

The usual small oval middle chamber lies directly behind stylet region and connects with anterior chamber by a canal (figs. 3, 4) which passes close beside the basis of the central stylet and which, though narrow, is broader than in many other Hoplonemerteans. Middle chamber, behind the stylet, is highly muscular, lined with flattened epithelium, and is often filled with fluid containing an abundance of granules resembling hardened secretions (fig. 3). These apparently originate in the posterior chamber, as described below.

The proboscis now bends sharply on itself in ordinary states of contraction and ends in an oval chamber with small lumen and very massive glandular walls (figs. 2-5, *pc*). The cells lining this chamber are highly columnar, irregularly arranged in several layers, and are thickly packed with secretions which have great affinity for ordinary stains. Posterior chamber closely imbedded in the surrounding connective tissue (figs. 4, 5), and this appears to be connected with the muscular walls of esophagus. Its movements are doubtless to a great extent dependent on the contractions of esophagus, which, as described below, is converted into a sort of muscular pharynx.

Body Walls.—Outer epithelium as in other genera, and richly provided with glands.

Muscular layers of body wall consist of a thin, external circular or oblique layer of muscles and an internal longitudinal layer (figs. 7, 8), somewhat thicker than the former, but yet thinner than in most related genera. Lateral nerves occupy the usual places internal to longitudinal muscular layer. In this species, however, they lie internal also to the thick layer of submuscular glands (figs. 4, 7, 8), and therefore nearer center of body than in other genera where these glands are not so highly developed.

There is very little body parenchyma, the intestine filling most of the space internal to the glandular layer, except at the time when genital products are developing.

Cephalic Glands.—Throughout the head the tissues are crowded with cephalic glands. Those situated more anteriorly open mainly on tip of snout (text-fig. 18; Pl. XIX, fig. 5, *cg*), but farther back they open directly outward on all sides of body.

Back of brain they pass gradually into *submuscular glands* which extend as a distinct layer throughout entire body. The glandular cells composing this layer open directly outward to the surface (figs. 4, 7, 8, *sg*) and are situated on the whole circumference of body immediately internal to the longitudinal muscular layer. The glandular layer is in most regions so massively developed that it exceeds in thickness all other layers of body wall combined. The secretions of these glands furnish the sticky mucus by means of which the worms cling so tenaciously to the crab or to other objects.

Alimentary Canal.—The esophagus, which leaves the rhynchodæum just in front of brain (Pl. XIX, fig. 5), passes beneath the ventral commissure as a narrow tube lined with rather flat cells, as in other genera. Just back of brain, however, it becomes enormously enlarged with high, columnar, ciliated epithelium, richly provided with gland

cells. This portion of esophagus is highly muscular and somewhat barrel-shaped (fig. 5, *e*), projecting a little way backward into the broad intestine which immediately follows posteriorly. Its posterior portion is therefore surrounded by the intestine, indicating rudiments of the intestinal cæca found in other genera. Intestinal canal broad, with short lateral pouches which become very much reduced toward posterior end of body.

Nervous System.—

The nervous system shows few deviations from that in related genera. Brain fairly well developed. From dorsal lobes a pair of large nerves pass anteriorly to eyes and anterior portions of head. These are easily seen in living worms. No indications of cerebral sense organs were found either when the specimens were stained *in toto* or when examined in sections.

Reproductive Organs.—The pouches of genital products become enormously developed and encroach greatly

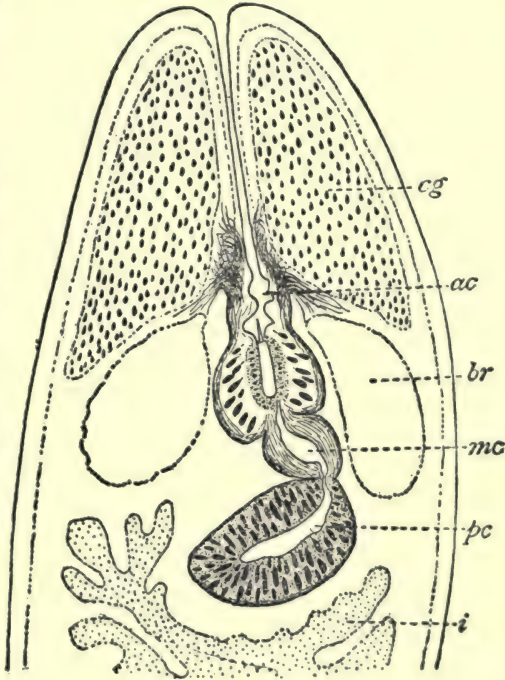


FIG. 18. *C. epialti*. Horizontal section through anterior portion of body; somewhat diagrammatic; *cg*, cephalic glands, *ac*, *mc*, *pc*, anterior, middle and posterior chambers of proboscis. $\times 125$.

upon the intestinal canal at time of sexual maturity (Pl. XIX, figs. 7, 8). Genital pouches extend farther forward than in almost any other Nemertean, reaching very nearly to brain. Ovaries (fig. 7, *ov*) regularly paired, with a single large pouch containing usually from twelve to thirty ova between each pair of intestinal lobes. Spermaries, on the other hand, far more numerous, surrounding intestinal canal on all sides. As many as fifteen or more separate spermaries (fig. 8, *t*) are sometimes found in a single transverse section of the body. As in most parasitic animals the abundance of sexual products is greatly in excess of that in related nonparasitic forms.

Habitat.—This is a much smaller and less slender species than *C. carcinophila* (Kölliker) Coe when sexually mature, and differs from it in regard to size of posterior chamber of proboscis, in the stylet apparatus, and in many other anatomical details, although the differences are not very considerable.

In general appearance, in color, arrangement of ocelli, esophagus, intestine, and brain the two species are very similar. *C. carcinophila* lives on the gills and among the egg masses of various species of crabs on the Atlantic coast of North America and on the coasts of Europe. *C. epialti* also lives when sexually mature among the egg masses of a crab—in this case *Epialtus productus*, the common kelp crab of the California coast.

Upwards of one hundred of these little worms were found among the eggs of a single crab at Monterey, Calif., September 3, 1901. In practically all, the sexual products were nearly mature, but no eggs were laid in confinement. The worm lived only a few days in a dish of sea water and appeared less hardy than the species on the Atlantic coast. I was unable to determine whether the worms pass their early life on the gills of the crab, as does *C. carcinophila*, but suspect that this may be the case.

7. AMPHIPORUS CRUENTATUS Verrill

Pl. xx, figs. 1-6.

Proc. U. S. Nat. Mus., II, p. 184, 1879.

Trans. Connecticut Acad., VIII, p. 399, Pl. xxxiii, figs. 7, 8; Pl. xxxv, fig. 3, 1892.

This species, which has previously been found only in New England, is fairly common among various growths on the rocks of the break-water at San Pedro, Calif. A number of specimens were also obtained from piles at Monterey, Calif.

Body small, soft, rather slender, usually 10-25 mm. in length, of a pale yellow, bright yellow, or sometimes flesh color, and having very conspicuous vessels with deep red blood, the color of which resides in the large, discoid corpuscles.

Head slender, with inconspicuous oblique furrows placed far back from tip.

Ocelli usually five to ten on each lateral margin of head (Pl. xx, fig. 6; text fig. 19), usually well separated, irregular in size and position; anterior ocellus on each side distinctly the largest and situated more superficially.

Proboscis very long and large, of a pale, slightly pinkish color.

Central stylet slender and acutely pointed, having a very slender basis of about the same length as stylet. Basis peculiar in that it is no wider, and is often narrower, posteriorly than at attachment of stylet. It is often irregular in shape (pl. xx, figs. 1-5) and about five or six times as long as its average width. Measurements vary from 0.07 to 0.1 mm. in length and 0.013 to 0.017 mm. in width. Two pouches of accessory stylets contain from two to four slender stylets each. Proboscis sheath reaches very nearly to posterior end of body. Retractor muscle of proboscis composed of about six strong fibers, attached in two groups to wall of sheath.

Blood system as in related species. In every individual of a large number of specimens the dorsal, or proboscis sheath vessel originated anteriorly from the right lateral vessel (text fig. 19).

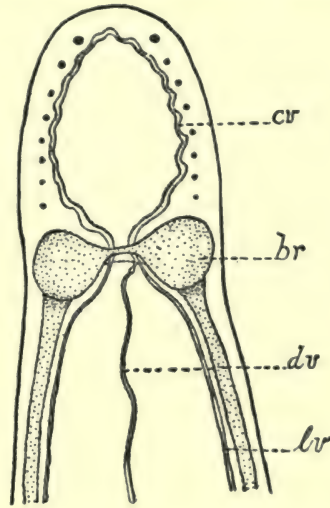


FIG. 19. *A. cruentatus*. Diagram of anterior portion of body, showing ocelli; *br*, brain; *cv*, *dv*, *lv*, cephalic, dorsal and lateral blood vessels. $\times 30$.

8. AMPHIPORUS PAULINUS Punnett¹

Proc. Zool. Soc. London, p. 92, 1901.

Punnett describes this new species from several specimens collected by Professor D'Arcy Thompson in the Pribilof Islands. This is described as being a slender form, 50-90 mm. in length and up to 4 mm. in greatest diameter. Color in life unknown, but after preservation the worms assume a pale yellowish brown color dorsally, and are almost white ventrally. Submuscular glands well developed, reaching back to intestinal region. Intestinal cæca do not reach nearly to the brain. Proboscis sheath extends only about six sevenths the length of the body; the proboscis is about three fourths as long as body and contains fifteen nerves. Its armature consists of central stylet and two pouches with four reserve stylets each. Basis is same length as central stylet. A single efferent nephridial duct lies on each side. Cerebral sense organs small, situated immediately in front of brain. There are numerous ocelli.

¹ For the sake of completeness this species is included here, although it has not been studied by the writer.

9. TETRASTEMMA SIGNIFER sp. nov.

Pl. XIV, figs. 9-11; XXI, figs. 10-12.

Body of moderate proportions or somewhat elongated for the genus, rounded throughout; not very changeable in shape. Head of moderate size, somewhat narrower than body, marked off from parts immediately following by rather conspicuous oblique lateral grooves; a second pair of similar oblique grooves lies farther forward on head, as shown in Pl. XIV, fig. 11.

Color.—General color of body deep reddish brown or purplish throughout esophageal and intestinal regions. In the intestinal region



FIG. 20. *T. signifer*. Outline of anterior portion of body, showing shape of cephalic marking and arrangement of ocelli. $\times 35$.

the color is rather more opaque than it is farther forward. Ventral surface of the same general color as dorsal, but of a duller tone, and often much paler in the median line. This paler median band is sometimes quite distinct in the anterior esophageal region. A little back of the posterior pair of oblique lateral furrows the reddish color of body suddenly ceases, and the whole head is white, or colorless, except for a characteristic large dorsal marking. This marking is of a deeper brown and less reddish color, and is usually situated just anterior to the posterior pair of ocelli, although the relative position of these parts is largely dependent on the state of contraction of the head.

In shape the marking resembles a wreath in heraldry (Pl. XIV, figs. 9-11; text fig. 20), having a transverse, posterior or basal portion from which two semicircular branches pass anteriorly, but do not usually join. A fourth portion of the figure passes forward in the median line from the basal portion to the anterior ends of the semicircular lateral bands, but does not usually join them. All these parts of the marking have irregular edges so that the wreath-like effect is made still more striking. The general effect is often that of an open wreath with vertical crossbar and substantial base, the whole figure appearing upon a white field. The wreath is not always open, for one or both of its anterior ends may join the anterior end of the median longitudinal bar. The whole figure is surrounded by white, and is separated from the reddish brown of the esophageal region by a fairly wide band of the same

color. This white color also covers the whole ventral side of the head, as is shown in pl. xiv, fig. 10.

After preservation, and even after imbedding in paraffin, the dark brown color of body and the white anterior portions with the peculiar cephalic marking remain almost as distinct as in life.

Blood vessels are distinguished easily because of their reddish color. This color is resident in the oval or rounded discoid corpuscles, as in several other species of the genus. The corpuscles are very flat, with several small pigment bodies in each.

Ocelli.—The four ocelli are of rather large size, and arranged nearly in the form of a square (text fig. 20). They lie deep in the tissues of the head, and occupy a variable position as regards the marking on the head, but in ordinary states of contraction the posterior pair lies just behind the basal portion of the marking, while the anterior pair is situated beneath the antero-lateral portions of the wreath, as indicated in pl. xiv, figs. 9–11. As seen in sections, the eyes lie deep in the midst of the cephalic tissues.

Size.—Length about 15–25 mm.; width commonly less than 1 mm.

Proboscis.—Of moderate size; whitish or pale flesh color. Muscular and other layers as in related species. There are ten proboscidial nerves. Central stylet slender, acutely pointed; basis conical, opaque and granular in posterior third (pl. xxi, figs. 10–12).

Body Walls.—Composed of the usual layers. The pigment which gives the body its color is found in a thin, but very dense, layer between the integument and the basement layer, and to a less degree among the bases of the epithelial cells of the integument. It is even more dense in the cephalic marking than elsewhere. Nearly the whole space enclosed by the body walls is occupied by the internal organs, so that there is but very little body parenchyma.

Submuscular glands are almost entirely wanting. Cephalic glands are but little developed. Practically the only glands, therefore, which open at the surface of the body are the integumental glands. It was noticed in life that the worms of this species were remarkably free from mucus. There are numerous forms in which an abundance of mucus is associated with an unusual development of the submuscular glands (in *Carcinonemertes epialti*, for example), so that it seems probable that these glands furnish a supply of mucus accessory to that of the integument.

Alimentary Canal.—A pair of very slender intestinal cæca extend forward to abut against the posterior faces of the dorsal brain lobes. For a considerable distance behind their anterior ends these cæca are

less than half as great in diameter as are the lateral nerves, close beside which they lie. Quite anteriorly they are situated above the nerves, then gradually assume positions immediately internal to them, and farther back, and after increasing somewhat in size, come to lie beneath, as well as internal to, the nerves. At a point about one-fourth the distance from the brain to the most anterior sexual glands the cæca of the two sides join to form a single broad chamber beneath the esophagus. This is provided with a few broad lateral pockets, which are but slightly differentiated from the main chamber. At about two-thirds the distance from the brain to the most anterior sexual glands the narrow esophagus empties through the dorsal wall of the broad intestinal chamber, which shows but slightly developed lateral pouches in front of the anterior sexual glands, although they are well developed farther back.

The anterior portion of the esophagus is lined with highly columnar ciliated cells, closely packed together with massive gland cells. These latter gradually disappear more posteriorly until there is only a single layer of short cells filled with a clear cytoplasm and provided with long cilia, which line the narrow posterior portion of the esophagus—or the 'pylorus' as it is called by Bürger.

Nephridial and Blood Systems.—The nephridia are remarkably limited in extent, but consist of unusually large tubules. They are situated above the lateral nerves, beside the esophagus, and immediately behind the brain. Two large canals often occur on each side, one of which lies above and the other below the slender intestinal cæcum. After a very short extent, they unite to form a remarkably large efferent duct on each side, which passes above the lateral nerves to open on, or immediately below, the lateral margin of the body as usual. In no other species of Nemertean have the efferent ducts been found to be of such great volume as compared with the size of the body.

The blood vessels show no remarkable deviations from those in related species. Many of the larger vessels are filled with large, oval corpuscles, with very distinct nuclei.

Sense Organs.—The cerebral sense organs are voluminous and highly specialized. They are situated immediately in front of the brain. The large duct with which each communicates with the exterior passes anteriorly to the ventro-lateral margin of the head as usual. The brain shows a correspondingly high degree of development, being remarkably large for the size of the body.

Reproductive Organs.—Sexual products are mature in August.

Habitat.—San Pedro Harbor, Calif., on piles of wharf; off San Pedro, in 3-6 fms. on hold-fasts of kelp; not very common.

10. TETRASTEMMA NIGRIFRONS sp. nov.

pl. xv, fig. 7; pl. xvi, figs. 6-9; pl. xvii, fig. 1; pl. xx, fig. 16;
pl. xxi, figs. 15-23.

Body of moderate proportions, or rather slender for genus, rounded throughout. Blood corpuscles red in color. Head more variable in size and shape than in many related species; provided with two pairs of lateral, oblique furrows of more than ordinary distinctness. In pl. xv, fig. 7 and pl. xvi, fig. 6, the head is represented as being well extended, while in pl. xvi, fig. 8, and pl. xvii, fig. 1, it is considerably contracted. The anterior pair of furrows lies between the anterior and posterior pairs of ocelli; each furrow extends on dorsal surface from lateral border obliquely backward toward the median line, but fades out gradually before meeting its fellow; on the ventral side the furrows extend obliquely forward and join in the median line not far behind the rhynchodæum opening (pl. xvi, fig. 7). The posterior pair of furrows is situated just behind the posterior pair of ocelli, and serves to mark off the head from the body. Conspicuous lateral constrictions at this point often accentuate the position of these furrows. They, too, pass obliquely backward on dorsal surface, but are not very distinctly marked in most cases.

Color.—In peculiarities of color and markings this species presents more variations than any other Nemertean described in this paper. A superficial examination led me to believe that no less than three species were represented by individuals which on more extended study were found to present all degrees of intergradation. They all agree in internal organization, and are all similar in having a whitish or pale yellowish head provided with a dark, dorsal marking of variable size and shape. The under side of head is whitish or very pale in all varieties. All agree, moreover, in having a deep red color in the blood corpuscles. The three more distinct color varieties suggest the varietal designations *purpureum*, *bicolor* and *pallidum*.

Variety *purpureum* (pl. xvii, fig. 1).—Head opaque white, with large, shield-like dorsal marking of very dark brown color. This marking is rounded in front, and deeply bilobed in the median line; it is somewhat wider posteriorly and commonly shows two conspicuous indentations near its posterior end; posterior border of marking usually straight. The white color of head extends a short distance back of the marking, or as far as the posterior oblique furrows, where it abruptly changes to a deep rich purple, which color extends to posterior end of body. The individual shown in pl. xvii, fig. 1, is represented as somewhat contracted, and the white color behind the marking

is consequently narrower than where the head is more fully extended. The line separating the white color of head from the purple of body is as sharp as possible. Ventral surface of same general color as the back, but somewhat paler and with a more reddish tinge; often with a much paler median band anteriorly. Color of ventral side of head whitish, separated abruptly from body color on a line corresponding to a similar line of demarcation on dorsal surface. Some of the purple individuals become reddish brown in intestinal region.

Variety *bicolor* (pl. xvi, figs. 8, 9). Head whitish with tinge of brown, with broad, triangular dorsal marking of dark brown. This marking is widest behind, with its obtuse apex in the median line anteriorly. Behind the head the color of body abruptly changes to deep rich brown, with a narrow median band of white. The brown color is deepest along the borders of the median white band, and is much paler laterally; toward the lateral margins of body it becomes pale brownish, and this color continues to the ventral surface, becoming gradually paler toward the median line. The ventral surface is therefore pale brownish, and this color continues on the ventral side of the head.

The third variety, *pallidum* (pl. xv, fig. 7), is much less deeply colored than those above described, and has a much narrower marking on the head. The marking is of the same deep brown color as in the other varieties, but is often less than one third as wide as the head. It is commonly acutely triangular with its pointed apex in the median line anteriorly. In this variety the ocelli are situated about half-way between the narrow marking and the margins of the head. The general color of head is whitish with a faint tinge of brownish. The whole body back of the head is of a pale brownish or buff color, or it is occasionally whitish with a faint tinge of brown. Oftentimes a paler, or whitish, line extends longitudinally on the dorsal surface, sometimes reaching posterior end of body. Ventral surface in this variety is pale buff throughout. The red blood vessels are naturally more conspicuous than in the darker varieties.

A variety which occurs on piles at San Pedro is deep flesh color with tinge of orange dorsally, and with dark brown cephalic marking. Ventral surface is grayish.

Another variety, common on the piles at Monterey, is shown in pl. xvi, figs. 6, 7. In this the head is opaque white with a moderately large wedge-shaped dorsal marking of dark brown color on head. Back of head and throughout body the color is reddish brown, thickly sprinkled with minute dots of darker color. Ventral surface

of head white, and this white color extends as a narrow band backward along ventral median line as far as the intestinal region (pl. xvi, fig. 7).

In some individuals of the other varieties mentioned a much paler band extends backward along the middle of the ventral surface in the esophageal region, and this band is often directly continuous with the pale color of the ventral surface of the head. In most cases this ventral band is not sharply demarcated, but shades off gradually into the darker color toward the sides of the body.

Other specimens are pale brick red in esophageal region, and chestnut brown posteriorly, with ventral surface grayish or pale reddish. In fact, there are all possible gradations between the most extreme color varieties.

Pigment to which color of body is due resides among the basal portions of the cells in the integument. The pigment of the cephalic marking, on the other hand, is situated among the cephalic tissues internal to the circular muscles. When the worms are kept for some time in stale sea water these outer tissues, including the pigment, are sloughed off, but the worms, which are very hardy, remain alive and crawl about for several hours more in this condition. Such worms are pale pinkish or flesh color with the ocelli and red blood vessels showing very conspicuously.

The general brownish color on the dorsal surface of the worms is retained after long preservation, and the cephalic marking is perfectly distinct even after imbedding in paraffin.

Ocelli.—The four medium-sized ocelli lie deep in the tissues of the head and occupy a variable position as regards the cephalic marking. Their position also varies greatly according to the state of contraction of anterior portion of body. When head is somewhat contracted the ocelli form a square (pl. xvi, fig. 8), but when well extended (pl. xv, fig. 7 and pl. xvi, fig. 6) the distance between anterior and posterior pairs of ocelli is considerably greater than between the two ocelli of the same pair. In an occasional specimen one or more of the ocelli are double, owing, no doubt, to fragmentation of the normal ocellus.

Size.—Largest specimens found were about 70 mm. long, and about 2 mm. in diameter, while the majority of sexually mature individuals were not more than 20–30 mm. long and 1 mm. wide. Many immature individuals were of much smaller size.

Proboscis.—Proboscis sheath extends to posterior end of body. Proboscis pale, often slightly pinkish. It is provided with ten conspicuous nerves. Basis of central stylet of the ordinary conical form,

with swollen, rounded posterior end. As shown in Pl. XXI, figs. 16-23, there is considerable variation in size and shape of basis. Figs. 22 and 23 were drawn from two specimens of the same color variety collected at the same time, and yet the difference in size and shape of basis is greater than commonly occurs between two related species. The central stylet is of moderate proportions, not particularly sharp, and is usually a little more than half as long as basis. There are commonly three stylets in each of the two lateral pouches, although there are sometimes four, or occasionally only two in one or both of the pouches. Measurements of several specimens show the following variations:

Length of Basis.	Diameter of Basis at Widest Part.	Length of Stylet.
.17 mm.	.10 mm.	.08 mm.
.15	.08	.09
.14	.07	.08
.14	.06	.07
.12	.05	.08
.11	.05	.07
.11	.05	.06

The length of the longest basis measured is therefore more than half as long again as the shortest, while the diameter of largest is just twice that of smallest. The length of stylet, on the other hand, is much less variable, the longest being only half as long again as the shortest.

The posterior portion of basis is dark and granular (Pl. XXI, figs. 16, 17), but gradually assumes the usual translucence in the anterior half.

Body Walls.—Integument and musculature as in related species. Pigment of dorsal surface situated among the basal portions of the integument. Basement layer of body walls thicker than in most species of the genus, and the species is also peculiar in having a rather large amount of body parenchyma separating the organs of the body. This parenchyma extends forward into the head in front of the brain.

Cephalic glands are fairly well developed and surround the rhynchodæum on all sides, but they do not extend back as far as the brain. Submuscular glands are wanting.

Alimentary Canal.—The rhynchocœl separates from the esophageal opening well in front of the brain, so that the rhynchodæum is unusually short. When the proboscis is partially extruded, the esophageal opening (mouth) appears almost like a separate aperture. A pair of slender diverticula of the intestinal cæcum reach forward to the dorsal brain lobes. They extend backward above the lateral nerves for some

distance, and then unite with the main cæcum, situated beneath the esophagus, as usual. Other pairs of slender diverticula are given off at intervals from the main cæcum, and these also pass forward to the dorsal side of the lateral nerves and end blindly at their anterior ends. The posterior portion of the esophagus is not very slender, and it unites with the intestine in front of the most anterior sexual glands.

Blood System.—The blood vessels are often very conspicuous in life, especially on the ventral surface of the body, because of their deep red color (pl. xvi, fig. 9). The coloring matter resides in the corpuscles themselves, which are oval and discoid. The union of the three longitudinal vessels at the posterior end of body is especially conspicuous, and corpuscles are seen to pass freely, but without regularity, in either direction in the same vessel. Their movement, either backward or forward, seems wholly dependent on the contraction of particular parts of the body, and is not controlled by any direct contraction of the walls of the vessels.

The blood vessels are also conspicuous in sections because of their content of large corpuscles with deeply staining nuclei. In many cases the vessels are so closely packed with these corpuscles that they are more conspicuous in the stained sections than most of the other organs of the body. The dorsal vessel lies within the rhynchocœl in the anterior portion of its course. The general relations of the vessels are as in related species, and the presence of the corpuscles allows the course of even the smaller vessels easily to be followed. Similar corpuscles are found abundantly in the rhynchocœl.

Nephridia.—The nephridial tubules extend from the brain region well back toward the end of the esophageal region. The tubules are largest anteriorly, where they ramify in the body parenchyma both above and below the lateral nerves, as well as beside, and a little in front of, the brain. There is a single pair of large efferent ducts, and usually one or more pairs of smaller ones. The large ducts are situated about on a level with the posterior ends of the dorsal ganglia, and pass obliquely downwards to open somewhat below the lateral margins of the head. Sometimes a second, smaller efferent duct lies near the larger one. Well back in the esophageal region a pair of smaller efferent ducts pass above the lateral nerves to open a little below the lateral margins of the body as usual. These smaller accessory ducts are not found in all individuals.

Cerebral Sense Organs.—These sense organs are situated some little distance—about their own diameter—in front of the brain, and somewhat nearer the ventral surface. The large ducts which com-

municate with the exterior pass anteriorly and ventrally to open on the latero-ventral aspects of the head, as usual.

Reproductive Organs.—Sexual products were found to be nearly mature early in September, but none of the eggs could be made to develop at this time by artificial fertilization. They are probably usually discharged late in September or in October. The sexual glands do not extend forward as far as the opening of the esophagus into the intestine, as they do in many related species. They are surrounded by a considerable amount of parenchyma, except when fully mature. The genital ducts were preformed as far as the basement layer of the body walls during the latter part of August. These ducts all open on the dorsal surface of the body, although in the male some of the spermaries are situated ventral to the lateral nerves. In such cases a long duct from each spermary passes internally to the nerve to open through the body walls above the lateral margin, as in the case of the glands situated dorsally.

Habitat.—Among algæ between tides, Pacific Grove; common. On piles of wharf, Monterey; abundant. In similar situations, San Pedro Harbor; not common. Collections of bryozoa and small algæ from piles at Monterey always furnished many specimens of this conspicuous, but variously colored species when left standing a short time in sea water. As noted above, these worms are very hardy, moving about actively for several hours after the pigmented integument has been sloughed off. When placed in formalin they do not break up spontaneously, but usually die intact and well extended.

11. TETRASTEMMA BILINEATUM sp. nov.

Pl. XIV, fig. 6; Pl. XXI, figs. 13, 14; Pl. XXII, fig. 4.

A minute species, measuring when sexually mature only 5 to 10 mm. in length, and less than a millimeter in diameter. Body rounded throughout, of moderate proportions, but rather shorter and stouter than in many related species. Head of moderate size, provided with two pairs of faintly-marked oblique grooves, but not distinctly separated from the parts following.

Color.—General color of body flesh color, creamy, or grayish, with two very conspicuous deep brown stripes extending along the dorsal surface nearly the whole length of the body. The longitudinal stripes are sometimes reddish brown and sometimes deep chocolate. The ventral surface is mainly grayish. Anteriorly the stripes terminate somewhat in front of the ocelli, but sometimes reach the very tip of the snout. Posteriorly they extend nearly, though not quite, to

the posterior extremity of the body, and are sharp and conspicuous throughout. The diameter of each stripe is perhaps one-sixth the diameter of body, and the two are separated about twice the diameter of each. In ordinary states of contraction the stripes are not quite as widely separated as are the ocelli, so that they pass medially to the latter. In preserved specimens the stripes retain their rich brown color even after imbedding in paraffin.

Ocelli.—The four ocelli are of moderate size, and, as in many related species, usually occupy the corners of a square (Pl. XIV, fig. 6). They are situated deep in the tissues of the head. There is no trace of pigment between the two ocelli of the same side.

Proboscis.—Presents few deviations from the normal type, and, as usual, is provided with ten nerves. Basis is of very small size, rather slender, and but slightly enlarged posteriorly. Its average length is only about .05–.07 mm. and its width .02–.025 mm. The central stylet is rather slender (Pl. XXI, figs. 13, 14); each of the two lateral pouches contains two or three accessory stylets. Proboscis is attached a little in front of brain; proboscis sheath does not extend quite to posterior end of body.

Body Walls.—The pigment which gives the brown color to the longitudinal dorsal bands (Pl. XXII, fig. 4, *fig*) is conspicuous in every transverse section of the body. It is not situated in the integument, but occupies the inner portion of the longitudinal muscular layer. Throughout the whole body, except in the head and most anterior esophageal region, the anastomosing pigment cells largely obscure the muscular fibers in the region where they are situated. This causes the longitudinal muscular layer to appear interrupted by an elongated dark mass on each side of the proboscis sheath. Just back of the brain, where the muscular layer is thickest, the pigment masses lie on the internal border of this layer, but farther back they occupy its whole thickness (Pl. XXII, fig. 4).

Submuscular glands appear only in anterior esophageal region, and are but little developed.

Alimentary Canal.—A broad intestinal cæcum extends forward through about half the length of esophageal region. It lies beneath and beside the esophagus, which opens through its dorsal wall posteriorly.

Nephridia.—Situated in the middle portion of the esophageal region. A single pair of efferent ducts passes immediately above the lateral nerves to open on the surface of the body just beneath the lateral margins. The efferent ducts are situated only a few sections posterior to the anterior end of the intestinal cæcum.

Nerves and Sense Organs.—Brain is of large size, with remarkably large ventral commissure. Cerebral sense organs remarkably voluminous, situated immediately in front of brain, and extending somewhat beside and beneath the ventral ganglion. Canal to exterior is of large size, and extends well forward toward tip of head, to open below lateral margin in a shallow oblique furrow.

Reproductive Organs.—Sexual products are mature in August. The most anterior reproductive pouches in the males are situated well forward in the esophageal region, or, in other words, well in front of the opening of the esophagus into the intestine. The anterior spermaries lie beneath the lateral nerves, but in the intestinal region, where several spermaries appear in each transverse section of body, they are found in smaller numbers above the nerves. The ovaries occupy similar positions in the female. The eggs when mature are very large in proportion to size of body, being fully one-third its diameter.

Habitat.—Common among bryozoa and tunicates (*Cione*) on piles of wharf in the harbor of San Diego, Calif.

12. TETRASTEMMA QUADRILINEATUM sp. nov.

Pl. XIV, fig. 5; Pl. XX, figs. 12, 13.

Body short, broad and stout; somewhat flattened, but with rounded edges. Head usually narrower than body; provided with the usual pair of lateral oblique grooves, which appear as slight constrictions opposite the posterior pair of ocelli. Intestinal region broad and somewhat flattened. Intestinal cæca not much branched; reaching nearly to brain region.

Color.—General color of body whitish, with four longitudinal deep brown stripes. Two of these stripes lie near lateral margins of body, while the other two are situated symmetrically on the dorsal surface. The two dorsal stripes are much the wider, and are each about equal in width to the white median stripe which lies between them. They are narrower on the head, and terminate anteriorly a little in front of the anterior pair of ocelli. Posteriorly they extend to the end of the body where they likewise become much narrower. These broad dorsal stripes are smooth in outline, but the lateral stripes, which are very much narrower, usually present a much broken and ragged appearance. In some individuals the lateral stripes are fully three-fourths as wide as the dorsal, but ordinarily they are less than half as wide. The two lateral stripes are strictly marginal, and ordinarily do not show from dorsal surface unless the animal is somewhat compressed. They each terminate anteriorly in the vicinity of the lateral

grooves on the head, or a little behind them. The white space separating the lateral from dorsal stripes is nearly equal to the width of one of the dorsal stripes. While the color of the stripes is always a deep rich brown (Pl. XIV, fig. 5), the whitish ground color is subject to considerable variation in different individuals and in different states of development of the sexual products.

The head is usually pure white except for the brown stripes; esophageal region commonly pure opaque white, although several mature male specimens were pale yellowish or flesh-colored in this region. Intestinal region commonly has a tinge of yellow or of pale salmon, due to the color of the intestinal lobes which show through the other tissues. When filled with mature ova, the intestinal region often has a yellowish or very pale greenish tinge, while the males may be pale flesh colored.

The ventral is of practically the same color as the dorsal surface, but the effect of intestinal lobes and sexual products is here more marked, so that in the intestinal region there is often a tinge of salmon (from the intestinal lobes), of flesh color, or of greenish yellow (from the sexual products). The color is also affected by the dorsal brown stripes which show through the other tissues to some extent.

Proboscis whitish; brain pale yellow in color.

The four dark brown stripes are quite as conspicuous after preservation, and even after imbedding in paraffin, as they are in life.

Ocelli.—The four medium-sized ocelli are arranged nearly in the form of a square in ordinary states of contraction of the head. Their relative position to the brown dorsal stripes is very variable, because they lie so deep in the tissues of the head as to be unaffected by the contraction of the superficial tissues in which the pigment of the stripes resides. Commonly, however, they lie in or just lateral to the brown stripes—the anterior pair lying near the anterior ends of the stripes, and the posterior pair about on a level with the lateral oblique grooves, as these appear on the margins of the head (Pl. XIV, fig. 5).

Size.—A small species, averaging only about 8–12 mm. long, and less than 1 mm. in width, when sexually mature.

Proboscis.—Proboscis sheath extends to posterior end of body. Basis of central stylet bell-shaped, short, much enlarged and rather abruptly truncated posteriorly (Pl. XX, figs. 12, 13). Central stylet about three-fourths as long as basis, rather small, but of typical proportions. Each of the two lateral pouches usually contains two accessory stylets, in size and shape like the central stylet. Basis measures about .06–.07

mm. in length, and .04-.05 mm. in diameter near base; central stylet .045-.055 mm. long.

Retractor muscle of proboscis attached to the dorsal wall of the sheath at about two-thirds the distance from head to posterior extremity of body. Proboscis of large size, provided with ten large and conspicuous nerves.

Body Walls.—The pigment of the four dark longitudinal lines appears perfectly black in mounted sections, and is always very conspicuous. It is situated in the basal portions of the integument.

Cephalic glands are well developed, and fill up a considerable portion of the tissues of the head in front of the brain.

Alimentary Canal.—A pair of broad diverticula of the intestinal cæcum extends forward above, and a little in front of the dorsal brain lobes. Shortly behind the brain the two diverticula join the broad unpaired cæcum which lies beneath the esophagus. This latter portion of the alimentary canal swells out into a large chamber immediately behind the brain, while its slender posterior portion (pylorus) does not empty into the dorsal wall of the intestine until well behind the most anterior sexual glands. The broad intestinal cæcum sends off a few pairs of large diverticula. The most posterior of these extend between the anterior sexual glands, while the most anterior pair terminates above the dorsal ganglia, as mentioned above.

Nephridia.—The nephridial system is remarkable for its short extent and for the fact that the efferent ducts open on the head immediately beside the dorsal ganglia. The nephridial tubules lie above the anterior portions of the lateral nerves, but do not extend more than a very short distance behind the brain. A few branches also ramify beside and a little in front of the dorsal ganglia. The efferent ducts are rather large, and open on the sides of the head about on a level with the middle portions of the dorsal ganglia.

Cerebral Sense Organs.—These are of moderately large proportions. They lie a little in front of the brain and somewhat nearer the ventral surface. The ducts communicating with the exterior pass anteriorly to open on the ventro-lateral aspects of the head as usual.

The *lateral nerves* unite above the posterior end of the alimentary canal.

Reproductive Organs.—The sexual products were found to be nearly mature in August. As in most species of the genus, the sexual glands are very voluminous, and occupy the greater portion of the body in the intestinal region. As stated above, the most anterior sexual pouches lie some distance in front of the opening of the esophagus into

the intestine. The distance from the tip of the snout to the anterior sexual pouches is therefore very short.

Habitat.—Among ascidians and other growths on piles of wharf in San Pedro Harbor, Calif.; fairly common. Sexually mature in August. Ova large, opaque; pale greenish in color.

This new species resembles both *T. vittatum* (Hubrecht) Bürger¹ and *T. quadristriatum* Langerhans² in general appearance, and in having four longitudinal brown lines on dorsal surface. In the former species, however, the four lines usually become confluent behind the head in two quadrangular patches which send two fine lines between the posterior pair of ocelli; in the latter species the two median lines extend to the tip of the head before uniting, while the lateral are interrupted between the ocelli and do not unite on tip of head. In *T. quadrilineatum*, as described above, the median lines reach nearly to tip of snout, but do not join each other, while the lateral lines usually end behind the ocelli.

13. TETRASTEMMA (ÆRSTEDIA) DORSALE (Abildgaard)
McIntosh

Planaria dorsalis ABILDGAARD, Zool. Danic., IV, p. 25, 1806.

Tetrastemma dorsalis MCINTOSH, British Annelids, Pt. I, Nemerteans, Ray Soc., p. 172, 1873.

Oerstedtia dorsalis Bürger, Fauna und Flora des Golfes von Neapel, Monogr. 22, p. 592, 1895.

This small, widely distributed species was collected by Mr. J. F. Abbott in about 20 fms. in Monterey Bay, Calif.

The species may be recognized by its firm, slender, cylindrical body, usually only 8–15 mm. in length, somewhat narrower toward both extremities; flesh color or pale yellowish, mottled on dorsal surface with brownish blotches and dots of various shades and with considerable variation in distribution, often being mainly collected into a series of transverse bands with a few scattered blotches between.

¹Hubrecht, A. A. W., Genera of European Nemerteans critically revised. Notes from Leyden Museum, p. 229, 1879.

Hubrecht placed this species in the genus *Ærstedtia*, but Bürger refers it to *Tetrastemma*. The specific name *vittatum* is preoccupied in *Tetrastemma*, however, by Verrill, who described and figured a widely different species under this name in 1874 (American Journal of Science, VII, p. 45). If Hubrecht's species actually belongs to *Tetrastemma*, it is obvious that it must receive a new specific name.

²Langerhans, P., Die Wurmfauna von Madeira, Zeits. f. wiss. Zool., xxxiv, p. 136–140, 1880.

The head is continuous with body and provided with four ocelli. Proboscis armature as in other species of *Tetrastemma*.

Habitat.—On piles of wharves, on rocks, among algæ, bryozoa, ascidians and other growths. Widely distributed in Northern Hemisphere, occurring on the northern coasts of Europe, in the Mediterranean and on both the east and west coasts of North America.

14. TETRASTEMMA (CERSTEDIA) RETICULATUM
sp. nov.

Pl. xiv, figs. 7, 8; Pl. xx, fig. 7-9.

A minute species measuring but 8-15 mm. in length when sexually mature, and less than 0.5 mm. in diameter. Body short, thick, rounded; much resembling *Oerstedtia* in form and movements, as well as in firmness of body and in general appearance. The peculiarities of the species are not sufficiently pronounced, however, to warrant its separation from the genus *Tetrastemma*. Head usually somewhat narrower than body, from which it is usually distinctly marked off by a pair of oblique lateral grooves. These lie opposite the posterior pair of ocelli (Pl. xiv, fig. 8), as in related species.



FIG. 21. *T. reticulatum*. Outline of anterior portion of body, showing position of ocelli and shape and arrangement of markings. $\times 40$.

Color.—General color of body white, with rectangular and longitudinal brown markings which obscure most of the white color of dorsal surface. Two varieties, presenting widely different arrangement of the dorsal markings, were met with, and these in extreme cases would suggest two different species. In both varieties the head, which is white or colorless, is provided with a very similar transverse deep brown marking between the anterior and posterior pairs of ocelli. This marking consists of a transverse band of color extending laterally somewhat beyond the ocelli, and having a rounded and deeply bilobed anterior margin (text fig. 21). It is often shaped like a dumb-bell, except that the contour is straight, and not indented, posteriorly.

In the most common variety (Pl. xiv, fig. 7) there are about sixteen pairs of rectangular brown markings situated on the dorsal surface and extending from the head to the posterior end of the body. These occupy the greater portion of the dorsal surface, leaving but little space

between and beside the rectangular marks for the white ground color. They are often decidedly irregular in shape, but in ordinary states of contraction of body average about one and a half times as long as broad, and are separated medially by a space about half as great as their transverse diameters. In addition to the sixteen pairs of rectangular marks, a pair of slender, irregular, brown lines are situated near the lateral margins along the whole length of the body behind the head. Anteriorly these slender brown lines join the more anterior rectangular markings, but at about the third pair of rectangular markings become separated, to join again at about the fourteenth pair. When the animal is slightly compressed, a narrow white margin appears outside these lateral brown lines. The fusion between the first pair of rectangular markings and the lateral lines is usually complete, while the second pair is often joined by only narrow bridges of the brown color (text fig. 21). Sometimes other pairs of markings are connected with the lines by similar bridges of color, and toward the end of body this is usually the case. At about the fourteenth pair of markings there is often a complete fusion of brown color, both of the lateral lines and of the rectangular markings of the same pair, and very commonly only a narrow, transverse band of white serves to indicate the division between the fourteenth and fifteenth, and between the fifteenth and and sixteenth, or last, markings. Often even this narrow transverse white band does not extend more than half way to the margins of the body. This fusion of all the brown markings is commonly limited to the three or four posterior pairs of markings, but in some individuals involves the greater portion of the dorsal surface. When carried to the extreme condition all the markings on the body back of the head are united, and this fusion gives rise to the second and less common variety.

In this second variety (Pl. XIV, fig. 8) the whole dorsal surface back of the head is of a deep brown color interrupted by about fifteen irregular, transverse, whitish bands reaching laterally toward margins of body. These fifteen whitish bands indicate the spaces between the sixteen pairs of rectangular markings described for the first variety. The lateral lines have become fused and lost in the rectangular markings, and both markings of the same pair have completely lost their individuality. Occasionally, however, a paler median line is indicated. Laterally, too, the adjacent pairs of markings have fused completely. Often the transverse whitish bands do not extend more than half way to the lateral margins, as was mentioned in regard to the caudal region of the first variety. They often become indistinct, and gradually shade

into the brown color laterally. Sometimes, moreover, the fusion is so complete that only a portion of the full number of transverse whitish bands can be found.

The brown color of body varies from a rather light brown to deep, chocolate brown or sometimes deep reddish brown. The whitish intermediate spaces are caused by absence of brown color, and are not due to any special pigment.

The ventral surface is commonly dull grayish with a tinge of yellowish in median line, but there are often numerous fine granules of brownish pigment scattered over the surface. The colors of the dorsal surface show through to some extent, and in the second variety the brown color often encroaches on the ventral surface and shades off gradually toward the median line. When full of ripe ova, the ventral surface of the intestinal region shows a broad lateral band of dull greenish tint due to the olive green color of the ova.

Ocelli.—The four ocelli are of medium size and, as usual, are arranged nearly in the form of a square (text fig. 21), although in ordinary states of contraction of head there is rather more space between the two ocelli of the same side than between those of either the anterior or posterior pair (Pl. XIV, figs. 7, 8). Moreover, the ocelli of the posterior pair often seem to be slightly farther apart than those of the anterior pair.

Proboscis.—Proboscis sheath reaches end of body as in related species. Proboscis pale flesh color, of large size as compared to body of worm. Basis of central stylet about two and one-half times as long as broad, somewhat elliptical, of nearly equal diameter throughout, and only a little wider posteriorly than near the attachment of stylet (Pl. XX, figs. 7-9). Posterior half of basis appears granular and dark, but becomes gradually lighter anteriorly until the anterior third is as translucent as in other species. Central stylet slender, about two-thirds as long as the basis. Each of the two pouches usually contains two accessory stylets. Measurements average about .05 mm. for the length of the central and largest accessory stylets, while the basis is about .07 mm. long and .025 mm. in average diameter. The proboscis is usually provided with nine nerves, although in a single specimen there was an indication of a tenth nerve.

Internal Organization.—The dark pigment of the dorsal surface of the body is situated among the epithelial cells of the integument, and extends upward among the cells well toward the surface.

Voluminous *cephalic glands* situated both above and beneath the rhynchodæum reach back nearly to the brain.

Alimentary Canal.—A pair of rather large diverticula of the intestinal cæcum reach forward to the brain, and pass to the dorsal side of the dorsal ganglia. They join the broad unpaired cæcum shortly behind the mouth. The cæcum extends backward beneath the esophagus, sending off a few broad diverticula. The narrow posterior portion of the esophagus does not join the intestine until after the appearance of several pairs of sexual glands. In this, and a number of other features, the species very closely resembles *T. quadrilineatum*.

Nephridia.—The nephridial system is limited to the region near the brain. Its tubules extend beside, as well as a very short distance behind, the brain. The single pair of efferent ducts open laterally just opposite, or a trifle behind, the posterior ends of the dorsal ganglia.

Cerebral Sense Organs are remarkably large. They are situated beside and beneath the ventral ganglia, and project somewhat in front of them. Large ducts pass antero-ventrally to the surface of the head, as usual.

Nervous System.—The brain is unusually voluminous; otherwise the nervous system agrees with that of related species.

Reproductive Organs.—Sexual products are mature in September. The ova are very large (about .18 mm. in diameter), pale olive green in color, arranged in a single row along each side of intestinal region. The spermatric pouches are correspondingly voluminous in the males. As stated above, the anterior sexual glands extend well in front of the posterior end of the esophagus (pylorus), so that but a comparatively short distance intervenes between them and the brain.

Habitat.—On piles of wharf in San Pedro Harbor, Calif., common.

15. *TÆNIOSSOMA PUNNETTI*¹ sp. nov.

Pl. xvi, figs. 1-3; Pl. xviii, fig. 6.

Body large, soft, flabby, extremely contractile, rounded in esophageal region, and much flattened posteriorly when extended; much like *T. princeps*² in shape, and, like that species, becoming very short and subcylindrical when strongly contracted.

Head and anterior portions of body extremely contractile; smooth and somewhat flattened when moderately extended, but abruptly truncated, cylindrical, and thrown into deep circular wrinkles when con-

¹ The species is named in honor of Mr. R. C. Punnett, of St. Andrews, Scotland, well known for his recent work on this group of worms.

² Coe, Proc. Wash. Acad. Sci., III, Pl. II figs. 3, 4, p. 62, 1901; also preceding article, pagged identically.

tracted. Snout small, rounded or emarginate in front, flattened considerably (Pl. XVI, figs. 1, 2), but may be almost completely withdrawn into the swollen succeeding portions of head, as shown in fig. 3. Oblique cephalic furrows lie on the ventro-lateral margins. As seen from in front when strongly contracted, the snout presents an elliptical outline, separated by a deep groove from the tissues of the succeeding regions, which have been moved forward to surround the retracted head (Pl. XVI, fig. 3). This groove passes through the cephalic furrows, and is continuous with them. The anterior portion of the esophageal region also is deeply wrinkled with circular grooves. Proboscis pore subterminal; proboscis rather small, whitish in color. Mouth extremely variable in size, according to state of contraction of anterior portions of body. When head is well extended the mouth is situated well back from snout and represents a large, much elongated opening (Pl. XVI, fig. 2), but when head is strongly contracted the mouth assumes the proportions of a small, rounded pore (Pl. XVI, fig. 3) on the ventral surface a little posterior to the retracted snout.

Esophageal region is often greatly swollen just behind the widely opened mouth when body is well extended, very much as in *Cerebratulus*. There are many indications that in this species of *Teniosoma* the esophagus is often filled with water, which is ejected at intervals, and thus serves to some extent as a respiratory organ, as has often been considered the case in *Cerebratulus*. The greater portion of esophageal region is subcylindrical, becoming more flattened posteriorly.

Intestinal region often very flat and ribbon-like (Pl. XVI, fig. 1), usually much wrinkled and showing a tendency to roll up into an irregular spiral, as has been noted in other species. This region may contract to but a small fraction of its usual length, becoming at the same time nearly as thick as broad. Posterior extremity not very slender.

Color.—General color of body usually deep brownish red, or dark red with only a tinge of brown; sometimes of a deep mahogany color. The body color often appears as if covered with a delicate whitish bloom. Anterior portion of head is much deeper brown or almost black, sharply marked off from a narrow white border which occupies the terminal and lateral margins of snout. The dark brown or blackish color is limited to the dorsal surface of snout, and usually consists of a rather narrow transverse marking which shades off gradually into the general body color posteriorly. It is bordered laterally by the white margin mentioned.

Ventral side of snout pure white, continuous with the white of the margins of dorsal surface, but this color does not commonly extend posteriorly to the snout. Occasionally, however, the white area extends back on the ventral side of the head proper, and may include the mouth region also. Back of snout the ventral color usually becomes gradually reddish, so that a pale red area generally surrounds the mouth (Pl. XVI, fig. 2).

Ventral surface of esophageal region of a brownish red color similar to that of dorsal surface, but of a much paler and more grayish shade. A much paler grayish median band is often found throughout the whole ventral surface. In intestinal region there is a similar pale brownish red color much influenced by the grayish color of the median intestinal canal and its lateral diverticula. These latter are conspicuous when the body is well extended, and add largely to the grayish effect of the ventral side of the whole intestinal region. Sometimes ventral surface is of the same brownish red color on the lateral margins as occurs on the upper side of body, but toward the middle line becomes much grayer and paler, while a median line of pure gray extends through the intestinal region.

The tissues of body in intestinal region show a general salmon or orange color when cut.

Size.—A large species, individuals often measuring 40–60 cm. in length and 8–10 mm. in width when extended. One of the preserved specimens still measures 20 cm. in length, and 5–7 mm. in width in intestinal region, and 12 mm. just behind mouth. When strongly contracted the body of a large individual may become but 6–8 cm. long, but is several times as thick as when extended.

Ocelli.—On each antero-lateral border of head is an irregular cluster of numerous minute ocelli. When cleared in cedar oil these appear distinctly as an irregular longitudinal row of forty to sixty or more small pigment spots just ventral to the dark head shield (Pl. XVIII, fig. 6).

Proboscis.—Proboscis sheath possesses an unusual length, extending backward throughout the greater portion of the intestinal region. Proboscis of large size, with two well-developed muscular layers—internal longitudinal and external circular—as usual.

Body Walls.—The three muscular layers are massively developed throughout the body.

Cephalic glands are enormously developed, as in most related species, and extend backward into the esophageal region. In front of the brain they encroach largely upon the muscular and connective

tissues surrounding the rhynchodæum and blood lacunæ, but are separated from the more superficial glands of the cutis by the rather thick layer of fibrous tissue which constitutes its inner portion. This line of separation is more marked on the dorsal than on the ventral side of the head. In the brain region the cephalic glands occupy a large portion of the longitudinal muscular layer on all sides of the body. In the region of the mouth they become more scattered, and lie mainly on the right and left sides, although they extend inward to the inner portion of the outer longitudinal muscular layer. Posterior to the mouth they are limited to the middle portions of the outer longitudinal muscular layer ventral to the lateral nerves, and occur only sparingly. They cease entirely a short distance behind the mouth.

The *cutis* is thick and, as in related species, consists of two conspicuous layers — an outer, glandular layer with closely packed, deeply staining gland cells, and an inner, fibrous layer consisting largely of interlaced connective tissue fibers. The cutis is several times as thick as the integument, and between the two lies a rather conspicuous layer of muscular and connective tissue fibers forming a basement layer for the integument.

Alimentary Canal.—As stated above, the mouth is remarkably distensible, appearing when contracted as a small round pore, but when distended is a large and long slit with thickened lips. The posterior end of the esophagus becomes much widened before it joins the intestine, and is peculiar in that it does not pass smoothly into the latter. The anterior end of the intestine proper is narrow, and opens into the widened esophagus immediately beneath the proboscis sheath, while the esophagus continues backward as a broad blind sac for some little distance, surrounding the lateral and ventral walls of the intestine. A section through this region, therefore, shows a rather small intestinal canal, surrounded, except dorsally, by the thick glandular walls of the broad, cæcal portion of the esophagus.

Blood and Nephridial Systems.—Cephalic blood lacunæ, lateral vessels and esophageal lacunæ as usual. Proboscis sheath vessel continues within the rhynchocœl nearly the whole length of the esophageal region. Nephridia remarkably extensive, originating a short distance posterior to the mouth and extending nearly the whole length of the esophageal region. The efferent ducts are numerous, but of small size. They are scattered at irregular intervals along the whole length of the esophageal region, and, as usual, pass to the exterior immediately above the lateral nerves. In the single specimen sectioned there were eight to twelve of these ducts on each side.

Nervous System and Sense Organs.—Brain and lateral cords as in related species. Cephalic and buccal nerves large.

Cerebral sense organs highly specialized, and of rather large size. They are much elongated, and their anterior ends are situated laterally in the angle between the dorsal and ventral ganglia. After extending back nearly to the posterior end of the dorsal ganglion, each sense organ enlarges until it is nearly equal in diameter to the dorsal ganglion, and eventually fuses completely with the posterior surface of the latter. At the narrow, anterior end of each sense organ a ciliated canal leads outward to open into the rather conspicuous oblique cephalic furrows.

Reproductive Organs.—Sexual products were found to be mature in the specimens dredged off San Pedro in August, but those examined at Monterey in September had neither ripe eggs nor sperm, and had evidently recently discharged their sexual products. The mature eggs are large and opaque, and when brought into sea water surround themselves with a jelly-like coating.

Habitat.—Dredged among red algæ, of color closely approximating that of the worms, in 50 fms., between San Pedro and Santa Catalina Island, Calif. This is a common species in that locality, and the individuals are remarkably hardy, living for a day or more among damp seaweeds. A number of large living specimens were obtained from Chinese fishermen, who caught them on their hooks in rather deep water (perhaps 10–20 fms.) in Monterey Bay, Calif. Just how the worms come to be caught on these hooks, which are set for ‘rock-cod,’ is difficult to imagine, unless they crawl about among the seaweeds on the bottom, and, as the hooks drag through, are caught in their bodies. It is possible that the worms actually find the bait and cling to it. The fact that the body is often entirely without injury points to this conclusion. The fishermen offered no conclusive evidence in the matter. The species must be abundant, or it would be more rarely caught on hooks.

Individuals live for a long time in captivity, and do not break up when roughly handled. They may be easily preserved without rupture, or without excessive contraction if killed slowly. Natural colors are well retained in formalin, but fade in alcohol.

16. *ZYGEUPOLIA LITTORALIS* C. B. Thompson

Zool. Anz., XXIII, p. 151, 1900.

Proc. Acad. Nat. Sci. Philadelphia, 1901, p. 657–739, Pl. XL–XLIV, 1902.

This very interesting species which has been so carefully studied and fully described by Miss Thompson (1902) occurs rather commonly

on the flats laid bare by the lowest tides in San Pedro Harbor. It has previously been recorded only from the vicinity of Woods Hole, Mass. The worms are found in sandy, and not in muddy locations.

The species may be recognized by the following characters: Body rather slender, usually 5-8 cm. in length, rather translucent. Head slender, when extended tapering to a fine point, without cephalic furrows; pure white in color. Esophageal region rounded; white, very

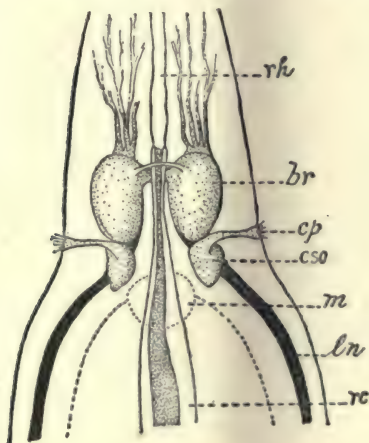


FIG. 22. *Z. littoralis*. Diagram of anterior portion of body, showing relation of cerebral sense organ (*cso*) to ciliated pit (*cp*) on side of head; *rh*, rhynchodæum; *br*, brain; *ln*, lateral nerve.

FIG. 23. *Z. littoralis*. Diagram of caudal cirrus and posterior end of body; *ln*, lateral nerve, extending into caudal cirrus (*ln'*); *in*, intestine; *a*, anus. Both figures after C. B. Thompson.



FIG. 23.

pale yellowish or flesh color. Intestinal region flattened in life, but rounded after preservation; color varies from rose to pale yellow, light brown or chocolate brown, being largely dependent on the amount and character of the contents of alimentary canal. Posterior extremity provided with a conspicuous, although slender, caudal cirrus, white in color (text fig. 23), with large central blood space.

In internal organization, the presence of an internal circular muscle at the beginning of intestinal region, the division of the anterior portion of alimentary canal into esophagus proper and stomach, the opening of the ciliated canals leading from cerebral sense organs into shallow lateral pits (text fig. 22, *cp*) in place of cephalic furrows, the absence

of any retractor muscle of proboscis, and the absence of the inner longitudinal muscle of proboscis, are among the more important peculiarities of the species.

In the paper referred to will be found detailed histological descriptions and figures of all the principal organs of the body.

17. *LINEUS RUBESCENS* sp. nov.

Pl. xiv, fig. 1; Pl. xv, figs. 3, 4; Pl. xxii, fig. 1.

Body very slender, rounded anteriorly, flattened in intestinal region; posterior extremity slender; head long, rather broad; cephalic furrows correspondingly long, reaching posteriorly as far as the anterior end of the mouth, which is situated well back from tip of snout.

Size.—A small species, the specimens obtained measuring only 10–15 mm. long, and less than 1 mm. in diameter.

Color.—Anterior portions of body, except tip of head, beautiful pink, or rosy flesh color, occasionally bright pinkish red, sometimes with tinge of blue. Tip of head, both above and below, whitish, almost colorless, sharply marked off from pink color behind. Intestinal region deep flesh color or pale, purplish brown, or occasionally buff, anteriorly, shading off to very pale pinkish towards posterior end of body; very pale posteriorly. Ventral surface paler, but of similar color, pinkish in front, pinkish buff or pale flesh color posteriorly; often with still paler median line. Intestinal lobes flesh color or buff; occasionally brownish or purplish. Head can be so much contracted that white tip will disappear. Brain appears pale flesh color. Space between ocelli is grayish. A most striking peculiarity of the color in the esophageal region is that it becomes purplish or, sometimes, bright blue in formalin. I know of no other species of Nemertean where the color changes from pinkish to bluish on preservation. The bluish color is not permanent, however, and after remaining a few weeks in formalin will have practically disappeared. But when such specimens are cleared in cedar oil, a delicate bluish or bluish green color reappears in the esophageal region, while the intestinal region remains colorless, except the intestinal lobes, which are slightly brownish. The nature and situation of the pigment are noted below.

Ocelli.—Situated in whitish area on tip of head is a row of two to four (or, rarely, as many as six or eight) ocelli on each side (Pl. xiv, fig. 1; Pl. xv, figs. 3, 4). These are irregular in shape, very dark reddish or almost black in color, and closely placed in a single row. The anterior ocellus on each side is usually the largest, but the ocelli

are often irregularly joined together, so that the individual ocelli cannot be distinguished, appearing rather as a row of scattered pigment masses on each side. In microscopic sections the eyes appear deep blue in color.

In internal organization the species shows many deviations from most other members of the genus although it is evidently closely related to *L. flavescens*. It presents a number of interesting anatomical peculiarities, which are noted below.

Body Walls.—At the point where the posterior esophageal cavity enters intestine, the circular muscular layer abruptly becomes less than half as thick as it is farther forward, and allows the outline of the body to become much wider and more flattened. In the esophageal region a cross section is but little wider horizontally than vertically, but in the intestinal region it is nearly twice as wide. This is due to the reduction of the circular muscular layer.

Extensive cephalic glands (pl. xxii, fig. 1, *cgl*) reach inward almost to the blood lacunæ in the anterior portions of the head, but do not extend behind the brain except on the ventral side, where they reach as far as the posterior ends of the cerebral sense organs. Beneath the rhynchodæum is a conspicuous canal (*a*) which passes forward and joins the rhynchodæum immediately where this opens on the ventral side of the tip of the snout. This canal is apparently the common duct of the cephalic glands which lie beneath the brain, for it originates posteriorly in a large cluster of these glands. Yet in no other species of Nemertean has such a well-developed duct been observed. Unfortunately the character of its lining is obscured by the secretions which it carries, so that its precise nature is not absolutely certain.

The glands of the cutis (pl. xxii, fig. 1, *cugl*) are extremely abundant in the head. They extend inward to the circular muscular layer throughout the whole intestinal region. Back of the mouth they sink gradually through the cutis and deeper into the external longitudinal muscular layer. In the region of the nephridiopores they have passed completely through this layer in a narrow area on the dorsal and on the ventral side, and have come in contact with the outer border of the circular muscular layer. Farther back the region in which the glands reach inward as far as the circular muscle becomes increased, until at the beginning of the intestinal region it extends along the whole circumference except in the vicinity of the lateral nerves. Throughout the length of the intestinal region these glands continue to border the whole surface of the circular muscles, except in the immediate position of the lateral nerves. Perhaps in no other member of the family

Lineidæ have these glands been found to be so extensive as in the present species.

Pigment.—The peculiar bluish color which appears after the worms have been preserved, and have consequently lost their original pink or reddish color, is due to a vast number of minute granules situated in the nervous plexus which lies immediately external to the circular muscular layer. The granules are present only in that portion of the plexus which lies dorsal to the lateral nerves.

Proboscis.—The proboscis sheath is remarkably long for the genus, extending very nearly to the posterior extremity of the body. The proboscis is of moderate proportions. In its musculature it exhibits an interesting departure from the type characteristic of the genus. The circular and outer longitudinal muscular layers are of the usual proportions, while the internal longitudinal musculature is represented by two bands placed symmetrically on opposite sides of the proboscis. These longitudinal bands occupy about one-sixth to one-eighth of the circumference of the internal epithelial layer, which elsewhere borders the inner face of the circular musculature. In thickness the two muscular bands, which represent the inner longitudinal musculature found in most related species, often equal that of the outer longitudinal layer in their middle portions, but are much thinner toward their borders. Back toward the middle portions of the proboscis they become gradually thinner, and more posteriorly eventually disappear, allowing the internal epithelium to border the circular muscles without interruption except from the nervous layer. Where the two longitudinal bands are present the proboscis nerves are well developed as a single pair of flattened cords which lie immediately external to those bands, but after the bands disappear, the nerves spread out as a plexus lying between the circular muscles and basement layer of the internal epithelium, as in related species. This peculiar arrangement of the musculature presents a condition intermediate between those members of the family Lineidæ in which the three layers are well developed, and those (such as *Lineus flavescens*, for example) in which the internal longitudinal layer is completely wanting. In the posterior portions of the proboscis only longitudinal fibers occur, and these are bounded externally by a thin fibrous layer, and internally by a thin epithelium lining the proboscis cavity.

Alimentary Canal.—Esophagus divided into two well-marked portions, separated by a constriction, and distinguished by differences in the epithelial lining similar to those which Miss Thompson has recently described for *Zygeupolia* (1902).¹ The mouth, situated as

¹ Proc. Acad. Nat. Sci. Philadelphia, 1901, p. 709.

usual, opens into the typical, broad esophagus with greatly convoluted walls lined with highly columnar ciliated epithelium and provided with an abundance of glands. Exactly in the region of the nephridiopores, however, or at about one-fifth the distance to the intestinal region, a marked change occurs. The esophageal lumen becomes narrow and situated immediately beneath the proboscis sheath, while beneath and beside it appears a second broad canal — posterior esophageal chamber or stomach, as it may be called. This is likewise devoid of lateral diverticula. A few sections back of the anterior end of this posterior chamber, the narrow, terminal portion of the esophagus proper, or anterior esophageal chamber, opens. The epithelial lining the posterior chamber differs conspicuously from that of the anterior chamber. In the latter the ciliated cells are situated superficially and their nuclei are not far removed from the surface, while the glandular cells lie mainly at a lower level and have their nuclei farther from the surface. In the posterior esophageal chamber, on the other hand, a comparatively small proportion of the cells are ciliated, and the nuclei of all are far removed from the surface. The cells are all very slender, and are thickly packed with small granules of secretions. The free surfaces of the cells appear to be irregular, and are covered with the secretion which partially fills the lumen of the esophagus, so that it is often difficult to determine exactly where the cells terminate. In this respect they differ greatly from those in the anterior chamber, where the ciliated cells always show a sharp and distinct free border.

The posterior chamber is fully four times as long as the anterior, and at its posterior extremity enters the broad cavity of the intestine proper, which is provided with the usual lateral diverticula, and exhibits the usual histological features. The transition from the posterior esophageal chamber to the intestine is very abrupt in both its anatomical and histological features. The circular muscular layer of the body walls becomes much thinner at this point, and the body is flatter and wider, as described above. The intestine at its anterior end becomes correspondingly wide and flat, with broad lateral diverticula. The lumen, on the other hand, becomes much narrower, and the epithelial lining several times as thick as in the posterior esophageal chamber. As in other species, the cells are large, without distinct outlines, and packed with peculiar spherical masses of deep-staining secretions. The nuclei are pushed deep into the bases of the cells. The general appearance, therefore, of these two portions of the alimentary canal is vastly different, although not so sharply marked as in other forms where the esophagus exhibits less specialized portions.

The posterior esophageal cavity — 'stomach,' or gastric portion of esophagus, as it may be called — is by no means a structure peculiar to the species at hand, for indications of a specialized posterior portion have often been described for the esophagus of other species. Yet in no other Heteronemertean has this chamber been found to be so highly differentiated. The transition is usually far more gradual, especially between the stomach and the intestine, as is the case in *Zygeupolia*. The general nature of the cavity resembles the intestinal cæcum of the Hoplonemerteans far more than it does the so-called 'stomach' (Magendarm) of these forms.

Blood and Nephridial Systems. — Cephalic blood lacunæ, lateral vessels, and anastomosing blood spaces about esophagus as in related species. Rhynchocæl vessel short, leaving the cavity of the proboscis sheath in the immediate vicinity of the nephridiopores, or at about one-fifth the distance from mouth to intestinal region.

Nephridial system remarkably short, but with rather large branches. It commences anteriorly a short distance behind the mouth and is limited to the anterior fifth of the esophageal region. The main longitudinal canal on each side is situated as usual in the angle between the proboscis sheath and the esophagus, and the branches ramify about the esophageal blood spaces. After an extent of less than one-fifth the length of the esophageal region, each of the two longitudinal canals swells out into a comparatively large chamber from which the rather large efferent duct passes above the lateral nerve to the nephridiopores, situated as usual on the dorso-lateral surface of the body. The nephridial canals do not extend farther posteriorly than the position of the nephridiopores, which are strictly paired.

Nervous System and Sense Organs. — These structures present no noteworthy peculiarities. Terminal, or frontal, sense organs apparently wanting. Cerebral sense organs well developed and closely united with posterior surfaces of dorsal ganglia. The canal by which each of the sense organs communicates with the posterior end of the corresponding cephalic furrow is broad and short.

Reproductive Organs. — No sexual products are present in specimens collected in August and September.

Habitat. — A few specimens of this beautifully colored species were found on piles in San Pedro Harbor, Calif. A single specimen was found by Mrs. Cockerell on a kelp 'hold-fast' outside the same harbor. The species also occurs sparingly on the piles at Monterey, Calif.

18. LINEUS FLAVESCENS sp. nov.

Pl. XVII, figs. 3, 4.

Body of moderate proportions for the genus; head long and rather slender, usually a little narrower than body, often pointed, and often slightly emarginate in front; cephalic slits longer than in most related species; esophageal region rounded; intestinal region only moderately flattened; posterior extremity rather slender, without caudal cirrus; proboscis sheath extends nearly to posterior end of body; proboscis rather slender.

Color.—General color of body yellowish, but of a great variety of shades in different portions of the body, and in different individuals. A number of specimens from crevices of rocks at San Pedro Harbor were pale yellow, sometimes with a tinge of orange, in esophageal region, and deep ochre throughout the remainder of the body except the head, which was ochre with a decided tinge of orange. Margins of head are paler. The pale yellow of esophageal region changes abruptly to the ochre of the intestinal region; posterior extremity and whole ventral surface of body of a duller, paler color.

Esophageal region often shows two distinct regions of different color, due to the two divisions of the esophagus described below. The anterior pear-shaped region lying next the mouth is more deeply colored, corresponding with the thicker esophageal walls, while the remainder of the region is usually paler (Pl. XVII, fig. 4).

Several specimens from among annelid tubes on San Pedro break-water were deep ochre anteriorly, with a sharp, median, dorsal, longitudinal white line which extended through the anterior half of the esophageal region. The remaining portion of esophageal region was greenish ochre, while the whole intestinal region was dull orange (due largely to the color of the intestinal canal), covered superficially by the pale yellowish of the body walls. Ventrally the color was dull whitish on head and in anterior esophageal region, then greenish ochre back as far as the intestinal region, which was of the same orange color as dorsal surface, but somewhat duller. Lateral and anterior margins of head colorless; cephalic slits long, sharply separating the ochre or yellowish orange of dorsal surface from whitish of ventral surface of head. Smaller specimens were commonly much paler in color. Some individuals were of duller colors, with dark buff intestinal regions.

Numerous large individuals taken in from 50–100 fathoms between San Pedro and Santa Catalina Island were of a rich golden brown anteriorly, with a tinge of yellowish orange on the head. Intestinal

region varied from ochre through deep buff to olive brown, sometimes showing a median dorsal longitudinal stripe of darker, more brownish color. These were filled with mature sexual products.

In all these varieties the brain region was indicated by its more rosy color, and this was sometimes quite conspicuous. The lateral and anterior margins of head were always very pale or colorless. The esophageal region showed clearly the two divisions of the esophageal walls, as seen through the somewhat translucent body walls. The ventral surface of head is much paler than dorsal surface, while throughout remainder of body the ventral differs from the dorsal surface in color mainly in having a duller and more whitish tinge. A paler median dorsal line in intestinal region, indicating the position of the proboscis sheath, is often present.

Proboscis straw color or slightly yellowish.

Size.—Small, pale-colored individuals were 8–15 mm. long; others 20–40 mm., while those from deeper water were often 80–120 mm. in length, with a diameter of 2–3 mm.

Ocelli.—On each side of tip of head is a transverse row of irregular pigment masses (Pl. XVII, figs. 3, 4). These are very variable in shape, in size, and in number, and vary in color from blood red to purple or black. There are commonly three to seven irregular groups of pigment granules on each side, and of these the more anterior are the larger. Those of the two sides are separated by a fairly wide pale area above the proboscis pore, and extend as a single row along each antero-lateral margin of the head. Commonly the ocellus lying most anteriorly is much larger than any of the others, while the three or four most posterior ones are represented by minute dots only. The number of ocelli may not be the same on the two sides, and perhaps in the majority of cases it is impossible to determine the exact number because the pigment granules are so much scattered. Often there is an irregular row of scattered pigment masses, grouped irregularly, but not arranged into definite ocelli. These appear to have arisen from a fragmentation of ocelli which have previously existed.

Whether the ocelli should be blood red, wine color, purple or black, seemed to be an individual peculiarity, and was not always correlated with the color of the body or the environment under which the animal lived. It is to be noted, however, that most of the individuals dredged among the red seaweeds had wine-colored or purple ocelli.

As seen in sections, only the anterior pair of ocelli usually possess a well-developed visual apparatus, with distinct, cup-shaped retina having long, spindle-shaped sensory cells. They lie very deep in the

tissues of the head on either side of the anterior end of the rhynchodæum. The retina faces ventrally. The remaining ocelli are much simpler in structure.

In internal organization this species shows a close resemblance to *L. rubescens*, and hence a considerable departure from the typical species of the genus in many details of structure. The close similarity in many anatomical features between these two species and *Zygeupolia*, as described by Miss Thompson (1902),¹ is very striking, and serves to unite this genus more closely to the other members of the Lineidæ.

Proboscis.—Proboscis sheath does not extend to end of body. Proboscis attached to dorsal wall of sheath at the posterior end of the esophageal region, and only a few sections in front of the intestine, by a powerful retractor muscle. In this same region the circular muscles of proboscis sheath extend ventrally to surround the esophagus with a rather thick layer of circular muscles. The fibers are connected to some extent with the main circular muscular layer of the body walls by a crossing of fibers immediately above the proboscis sheath. This recalls the great thickness of the inner circular muscles found in this same region in *Carinoma*. A similar condition has been described for *Micrura alaskensis* (Coe, 1901),² and Miss Thompson (1902)³ has recently described for *Zygeupolia littoralis* and *Micrura cæca* a well-defined inner circular layer in this region, and has shown its apparent homology with the inner circular muscular layer of *Carinella*, *Carinoma* and other Paleonemerteans.

This localized inner muscular layer doubtless serves the double purpose of holding the proboscis sheath, with its attached proboscis, firmly in place among the other tissues, and of providing a strong annular constriction between the esophagus and intestine. By the action of this sphincter, food materials, having entered the intestine, may be prevented from returning to the esophagus. Furthermore, the esophagus may under some circumstances act as a respiratory organ, as described by Wilson (1900)⁴ for *Cerebratulus lacteus*, and as I have observed in other species, and in this case the muscular constriction will prevent the water from passing back into the intestine.

The muscular walls of the proboscis consist of the outer longitudinal and inner circular layers only. The inner longitudinal layer, which is

¹ Proc. Acad. Nat. Sci. Philadelphia, 1901, pp. 657-732.

² Preceding article, p. 72.

³ Loc. cit., p. 667.

⁴ Quart. Journ. Micr. Sci., XLIII, p. 109.

represented in *L. rubescens* merely by two bands of longitudinal fibers (as described on p. 181), is here wanting completely. The two proboscis nerves are conspicuous in the anterior portions, but farther back spread out into a plexus as usual. The basement layer of the proboscis epithelium is therefore separated from the circular muscular layer only by the nerves or nervous plexus, as described on p. 181 for *L. rubescens*. A precisely similar condition has recently been described for *Zygeupolia* by Miss Thompson (1902),¹ and is known in other species of the Lineidæ.

Cephalic glands are well developed, but extend backward only to the anterior portion of the brain region.

Cutis Glands.—In the esophageal region the cutis glands form a thick and distinct layer in the midst of the outer longitudinal muscles. Anteriorly they lie well toward the periphery of this muscular layer, but sink gradually deeper until in the nephridial region they lie in contact with the circular muscles dorsally and ventrally. This condition is retained in the intestinal region, as was described for *L. rubescens*.

Cephalic Furrows.—These are deep, and broaden out dorso-ventrally on their internal faces near their posterior ends. The canal leading to the cerebral sense organ on each side joins the posterior, broadened end of the corresponding cephalic furrow through a broad papilla.

Alimentary Canal.—Mouth large, elongated, situated opposite posterior ends of cephalic slits. As stated above, the esophagus is seen in the living worm to be divided into two distinct regions. These consist of an anterior, pear-shaped cavity (Pl. xvii, fig. 4) immediately behind the mouth and a posterior tube, or posterior esophageal chamber, connecting with the intestine. The anterior cavity is distinguished by its much thicker, convoluted walls and deeper color. At its posterior end this chamber is widened considerably, and is then abruptly constricted as it opens into the posterior esophageal chamber, or stomach. This latter portion has thinner walls and paler color, and likewise exhibits a constriction just before it opens into the intestine. There are very marked histological differences between these two portions of the alimentary canal, but the conditions are here so very similar to those described for *L. rubescens* that the detailed descriptions given on p. 182 apply equally well for the species at hand. Perfectly similar conditions have recently been described for *Zygeupolia* and other forms.

The remarkable development of circular muscles about the posterior

¹ *Loc. cit.*, p. 693.

end of the esophagus forms a strong sphincter between the posterior esophageal chamber (stomach) and the intestine, as described above.

Blood and Nephridial Systems.—Cephalic and esophageal lacunæ as in related species. Proboscis sheath vessel passes outside rhynchocœl in the nephridial region, or at about the point where the anterior esophageal cavity opens into the stomach.

The main nephridial canals are of large size, but of limited extent. They are situated beside the posterior fourth of the anterior esophageal chamber, and the anterior third of the posterior esophageal chamber, or stomach. In one small specimen sectioned there was but a single pair of large efferent ducts, while in a larger individual there were two pairs. In the former case the ducts were exactly paired, while in the latter both the ducts on one side were in front of the more anterior of those on the other.

Nervous System.—Brain and nervous system show no marked deviations from the condition typical of the genus. The frontal sense organ appears to be represented by a crescent-shaped groove above the subterminal proboscis pore.

Habitat.—In crevices of rocks between tides, Dead Man's Island, San Pedro Harbor; among annelid tubes, breakwater, San Pedro, Calif.; not very abundant; one specimen from a floating kelp 'hold-fast' off San Pedro Harbor (Mrs. Cockerell); common among red algæ in 50 fms. between San Pedro and Santa Catalina Island.

The worms belonging to this species are remarkably hardy and will live for more than a day in damp seaweed at a temperature of 70–80° F., and may be kept for a long time in confinement in a small quantity of sea water. Sexual products appeared to be fully mature in August, but in some individuals had been previously discharged.

19. LINEUS PICTIFRONS sp. nov.

Pl. xvii, figs. 5, 6.

Body of large size, remarkably soft and flabby, very changeable in shape, but usually somewhat flattened throughout. Body often snarled and tied in knots; much fluted longitudinally, and constricted transversely when contracted. Head narrower than body, elongated, often emarginate in front, narrower at posterior end of cephalic slits than in its middle portion. Cephalic slits unusually long, rosy in color posteriorly, sometimes bordered by a narrow line of white. When contracted, body is thick, and not flattened, except near anterior end. Posterior extremity rather slender, rounded, not flattened.

Color.—General color of body, both above and below, deep brown,

chestnut, or slaty, with a tinge of green in reflected light, or of plumbago or bluish when seen in shadow. Sometimes a reddish tinge is given to the brown, and there is usually a soft, velvety sheen. Head has a rosy or chestnut tinge beneath the brown. Tip of tail very pale in color.

Throughout the whole body is usually found a series of transverse and longitudinal yellowish markings on dorsal surface. The transverse markings are the more conspicuous and consist of a series of lemon yellow rings. The more anterior of these commonly encircle the whole body, while farther back they appear on dorsal surface only. They are all much widened in the median line, and in some specimens appear to consist only of a series of diamond-shaped median markings. More commonly, however, each marking continues laterally as a fine line which completely encircles the body, although many are interrupted on the ventral surface. In the posterior half of the intestinal region these markings do not usually appear on the ventral surface. In some specimens the markings are very much obscured and occasionally are almost completely wanting. The first transverse marking occurs at the posterior end of the cephalic furrows, and this is usually much larger and more conspicuous than any of the others (pl. xvii, fig. 5) although it does not extend to the ventral surface. On a worm of 10-20 cm. in length there are usually sixty to one hundred or more of these transverse rings.

The dorsal surface is corrugated with longitudinal flutings, except when the animal is fully extended. These flutings are accentuated by very fine, hair-like longitudinal lines of ochre or orange color which extend throughout most of the dorsal surface. They are not only very fine, but are much interrupted and irregular, usually wavy, and often consist of rows of elongated dots of color. On the head the lines are much interrupted and consist mainly of rows of very minute dots. On the ventral surface they are entirely wanting throughout the body. On the dorsal surface there are commonly about seven to fifteen or more of the fine lines, of which the one in the median dorsal line is more distinct than the others, and connects the transverse, diamond-shaped, pale yellow markings described above. On each side of the median line the lines are sometimes arranged rather symmetrically, but are sometimes almost entirely lacking. This is often the case in the posterior half of the body. In many specimens the lines are seen only when very carefully examined, and in some others appear to be entirely lacking. Sometimes they are wanting anteriorly to the third or fourth transverse yellow marking. The transverse markings are of a much paler yellow than are the longitudinal lines.

Especially characteristic is the peculiar coloring on the tip of the head, and this has suggested the specific name. On the dorsal surface near tip of snout is a narrow terminal border of white, and situated within this white border are two oval, orange-colored spots imbedded in an area of lemon yellow (Pl. XVII, figs. 5, 6). Sometimes a few isolated dark brown dots are scattered in the yellow color. In some specimens the orange-colored spots are very conspicuous, while in others they are very small and indistinct. Sometimes the yellow color surrounding them is wanting, but the white terminal border is always present on the tip of the snout, both above and below.

After preservation in formalin the head becomes much contracted and wrinkled, the cephalic slits become short, and the body assumes a dull black or slaty color, without indications of the characteristic yellow markings seen in life.

Mouth large, with pale lips, reaching forward to the posterior ends of the cephalic slits.

Proboscis salmon or flesh-colored, very long and slender.

Size.—Usually about 15 cm. in length and 3–4 mm. in width, although individuals were found as small as 15 mm. long, while a single specimen measured nearly 50 cm.

Proboscis.—Provided with two muscular layers only, the internal longitudinal muscles being wanting. There is a well-marked crossing of fibers between the circular muscles and the outer fibrous layer, as in many related species.

Body Walls.—Structure of body walls as in other representatives of genus. The pigment which gives the dark color to the body is situated as a very dense layer of minute pigment granules immediately beneath the epithelium throughout the whole length of the body. It is even present as a less distinct layer beneath the epithelium of the cephalic furrows, and is lacking only in a narrow area immediately surrounding the proboscis pore. This area corresponds to the white zone seen in life at the tip of the snout. So dense is the pigment layer that if ocelli were situated in it they would be very difficult to distinguish. They are probably not present, however, for they do not appear in any of the sections.

A rather thin layer of connective tissue is found beneath the cutis glands, which indicates an approach to the condition of a true cutis. The cutis glands are massed in a distinct layer just beneath the pigment layer, and do not extend among the fibers of the outer longitudinal muscles even in the intestinal region. They are usually distinctly, though not widely, separated from these muscles by the thin fibrous layer.

Cephalic glands form a voluminous and well-marked mass of deeply staining glands which extends back both dorsally and ventrally nearly to the brain. Their secretions are discharged anteriorly at the tip of the snout as in the Tæniosomidæ.

Alimentary Canal.—The esophageal region is remarkably short in comparison with the total length of the body. There is a very short esophagus lined with the characteristic glandular and ciliated cells. At the posterior end of this is a decided constriction, or sphincter, which opens into a widened posterior chamber without lateral pouches, but having a lining of epithelium not widely different from that of the intestine. This posterior cavity is even shorter than the esophagus proper, and gradually passes into the true intestine with its paired lateral pouches. The esophagus proper is sometimes only as long as the transverse diameter of the body, and hence, much shorter than in most related species. The cavity behind this evidently corresponds to the 'stomach,' as described by Miss Thompson (1902)¹ for *Zygeupolia*, and is doubtless homologous with the posterior esophageal cavity of *Lineus rubescens* and *L. flavescens*, as described above. In these latter species, however, the epithelial lining of this cavity is markedly different from that of either the esophagus or intestine, while in *L. pictifrons*, as in *Zygeupolia*, it resembles the intestinal epithelium very closely.

Although the change from esophagus to 'stomach' is very abrupt both anatomically and histologically, yet it is quite impossible to determine exactly where the stomach ends and the intestine proper begins. The anterior intestinal pouches are but slightly indicated and pass gradually into the wavy outlines of the stomach, and the histological features show a similar gradation. The cells of the axial cavity of the intestine retain the appearance of the stomach cells for some distance posteriorly as in *Zygeupolia*.

An internal circular muscular layer, such as is described above for *L. rubescens* and *L. flavescens* just anterior to the intestine, is not found in the present species.

Blood and Nephridial Systems.—There is the usual arrangement of cephalic blood lacunæ, lateral lacunæ, rhynchocæl vessel, etc. Branches of the lateral lacunæ surround the esophagus, and are gathered into a single pair of vessels in the region of the stomach. In this region there are five large vessels in a transverse section of the body—the rhynchocæl vessel, the pair of lateral lacunæ situated in the angle between stomach and proboscis sheath, and the pair of ventral vessels

¹ Proc. Acad. Nat. Sci. Philadelphia, 1901, p. 709.

situated latero-ventrally beneath the stomach. At the beginning of the intestinal region the lateral lacunæ pass ventrally to join the ventral vessels, which continue to posterior end of body. The rhynchocœl vessel passes beneath the proboscis sheath at the beginning of the intestinal region.

The nephridia are limited to about the middle half of the very short region of the esophagus proper, and are consequently much less extensive than usual. The main longitudinal canal on each side lies on the lateral wall of the lateral blood lacuna and sends branches among the esophageal lacunæ. A single pair of efferent ducts pass to the exterior above the lateral nerves as usual. In one individual, one of the efferent ducts was peculiar in that it branched just outside the circular muscular layer. Only one of its branches passed to the exterior while the other penetrated only about two-fifths the distance through the outer longitudinal muscular layer.

Nervous System and Sense Organs.—The species is remarkable in having many of the smaller nerves far more conspicuous than in most other species. The cephalic nerves, for instance, are unusually large and numerous. Esophageal nerves are also large, with a distinct commissure near their point of origin from the ventral brain lobes. These nerves join in a distinct plexus beneath the esophagus a short distance behind the mouth. The dorso-median nerve is clearly marked and of remarkably large size. The internal dorso-median nerve, found in many species directly beneath the former and internal to the circular muscular layer, is likewise well developed in this species.

The brain is massive. The cerebral sense organs are correspondingly voluminous, and as usual are bathed posteriorly in the large lateral blood lacunæ. The cephalic furrows are of moderate depth, and their lining of regularly arranged epithelial cells with long cilia furnishes strong evidence of their sensory functions.

Reproductive Organs.—Sexual products are fully mature in August.

Habitat.—One specimen measuring nearly half a meter in length was found by Miss Robertson, of the University of California, in the crevices of a rock at Dead Man's Island, San Pedro, Calif. Other specimens of much smaller size were found among worm tubes and under stones in the same locality. The species is rather common in mud among tunicates growing on the piles of wharves in San Pedro Harbor, where the worms are usually from 15 mm. to 15 cm. in length. Dredged in several localities off San Pedro in 2 to 20 fms.

20. LINEUS ALBOLINEATUS sp. nov.

Pl. xvii, fig. 2.

Body of moderate proportions for genus, rounded in esophageal region and flattened posteriorly. Esophageal region longer in proportion to length of body than in related species. Head short, broad, commonly a little wider than neck, but not distinctly demarcated, often slightly emarginate in front, flattened moderately. Cephalic furrows deep, of moderate length, and, in most states of contraction of head, well separated anteriorly; when strongly contracted, however, reaching nearly to proboscis pore as usual. Mouth small, situated about as far back as posterior ends of cephalic furrows. Proboscis small, with peculiarities as described below.

Color. — General color of body deep chocolate brown or olive brown, with very conspicuous, clearly marked, white or pale lemon yellow stripe extending whole length of body in the median dorsal line. On the head this median stripe widens out to form a broad, pear-shaped white marking (Pl. xvii, fig. 2) which is often two-thirds to three-fourths as wide as head. It is broadest, and often slightly emarginate, very near the tip of the snout, gradually becoming narrower through about half the length of the head, where it is lost in the dorsal stripe which continues throughout the body. The narrow terminal border lying in front of the white marking on head is paler brown and more reddish than the general color of body. In some individuals a faint reddish line extends from each cephalic furrow backward along the lateral margin of the body. Occasionally this line becomes quite distinct.

Ventral of same color as dorsal surface. A more rosy coloring marks the position of the brain. Cephalic furrows often marked by a slightly paler, rosy color. Intestinal region inclining toward an olive brown shade. White dorsal stripe very sharply marked, without gradation into adjacent color. It averages about one eighth as wide as body, but is rather more irregular and less conspicuous posteriorly.

Ventral side of head reddish brown; tip of snout ventrally more distinctly reddish; mouth reddish inside, lips paler.

In formalin, and even after imbedding in paraffin, the worms retain their dark brown color with the strongly marked dorsal stripe and cephalic marking as in life. In addition, a pair of narrow lines of light color appear on the lateral margins, corresponding to the faint, reddish lines seen in life. They are continuous with the cephalic furrows, and lie exactly on the lateral margins throughout the body.

Size. — Length 100–150 mm. in extension; width 2 mm. or more.

Ocelli. — Apparently wanting, although some irregular masses of reddish brown pigment on the sides of the head may perhaps be concerned with light perception.

Proboscis. — The pair of proboscis nerves lying internal to the circular muscular layer are remarkably conspicuous. Inner longitudinal muscular layer almost completely wanting; consequently the pair of nerves appear to lie directly beneath the inner epithelial layer. Fibrous crosses between the internal and external muscular layers are very inconspicuous, although they are sometimes indicated. In many respects, therefore, the structure of proboscis approaches the condition found in *Teniosoma*. Proboscis is attached posteriorly at the boundary of esophageal and intestinal regions by a broad and powerful muscle to the dorsal wall of the proboscis sheath. Posteriorly to this point the cavity of the sheath is very small, and does not extend very far back into the intestinal region.

Vascular System. — A very large and extensive unpaired blood lacuna is situated in the head in front of the brain, and completely surrounds the walls of the rhynchodæum, except on the ventral side. Just in front of the brain the lacuna becomes broken up into smaller spaces, which unite about the cerebral sense organs into a single extensive lacuna on each side. These two large spaces are separated only by a thin strand of tissue. Back of the mouth each sends off a series of large anastomosing blood spaces around the lateral and ventral walls of the esophagus. These esophageal lacunæ extend back nearly two-fifths of the length of the esophageal region, where they unite again with the lateral vessels, which have continued in the angle between the proboscis sheath and esophagus.

Nephridia. — The nephridial system is very short and is limited to the second fifth of esophageal region. It is remarkable for the small number and comparatively large size of its branches. The anterior branches lie on the outer walls of the esophageal blood lacunæ, while the main longitudinal canal on each side lies above the esophagus and ventral to the large lateral blood lacuna. After extending backward for a distance of about 0.3 mm. (in an individual 100 mm. long) the branches in the esophageal lacunæ join the main nephridial trunk which passes to the dorsal wall of the lateral blood lacuna. The blood vessels around esophagus extend posteriorly only as far as the most posterior of these branches. The main nephridial trunk on each side then becomes situated in the connective tissue just above the lacuna and extends backward in this position, and without branching, for a dis-

tance fully equal to that occupied by its branches, or about 0.35 mm. The efferent nephridial duct passes directly outward from the posterior end of the longitudinal canal and opens externally a little dorsally to the lateral margin of body.

Cephalic glands remarkably voluminous, reaching deep into tissues of head—fully three-fourths the distance from exterior to rhynchodæum—and extending posteriorly almost to the anterior end of the brain region, where they cease abruptly and completely.

Body Walls.—The dark pigment which gives the deep color to the body, and which is not soluble in alcohol, cedar oil or xylol, is situated among the cutis glands in the outer longitudinal muscular layer in small amount, but its chief position is in a conspicuous layer just outside the circular muscles. In the head it is scattered through the deeper muscles and connective tissues. It is especially abundant between the cephalic furrows and the rhynchodæum.

In the anterior esophageal region the cutis glands reach inward entirely through the outer longitudinal muscular layer, except in the vicinity of the lateral margins.

Frontal sense organs not developed as special sensory pits.

Nervous system presents no marked peculiarities. Dorsal nerve is fairly conspicuous immediately behind brain, but is very little developed farther back.

Reproductive Organs.—From specimens collected in August, the genital products had evidently been recently discharged.

Habitat.—Dredged in 30 fms. off Point Fermin, near San Pedro, Calif. But few specimens were found, and these inhabited strong, parchment-like tubes among broken shells. Found also in 20 fms. in Monterey Bay, Calif. (J. F. Abbott.)

The species somewhat resembles the variety of *Lineus bilineatus* figured by Bürger in his Naples Monograph (pl. v, fig. 15) in regard to the markings on the anterior portions of the body, but is much less slender, and shows many anatomical differences.

21. LINEUS WILSONI sp. nov.

Pl. xvi, figs. 10, 11.

Body only moderately slender, rounded anteriorly, flattened in intestinal region, but with rounded lateral margins. Body is sometimes wider in the intestinal region than the figure indicates. Head long and slender, not marked off from body, but somewhat narrower just back of brain; cephalic furrows correspondingly long. Intestinal

region commonly much wrinkled and with numerous constrictions. Posterior extremity not very slender.

Body fragile, often constricted at the white rings described below, and it is through these rings that the rupture usually takes place. Several individuals broke spontaneously at the third ring, while the rings in front and behind remained intact. This third ring seemed to be the usual position of the first rupture.

Mouth large, situated immediately behind brain.

Proboscis pore subterminal, near ventral margin of terminal white border. Proboscis slender, color very pale, with a tinge of yellow. Proboscis sheath extends very nearly to the posterior extremity of the body. *Ocelli* wanting.

Color.—General color of dorsal surface deep chestnut brown, slaty brown, purplish brown, or occasionally dark drab, the shade varying considerably in different parts of body. Some individuals are chocolate brown in esophageal region and are much paler brown posteriorly. The under side of the body is sometimes dark brown like the dorsal surface, but is usually paler, with a tinge of gray, and is occasionally light drab. Those individuals which have the less deep coloring on the dorsal surface have a correspondingly lighter tone on the under side of the body. When the intestinal lobes show through they appear to be still lighter in color.

Head bordered anteriorly by a narrow terminal band of white which also extends back along the borders of the cephalic slits. The white color extends back a little farther in the median line than elsewhere, except on the margins. Sometimes the white color extends backward to the posterior ends of the slits, both above and below, so that when the slits are open they appear white in color (Pl. XVI, fig. 10). White terminal border is a little less broad on ventral than on dorsal surface and is less conspicuous owing to the paler color of the ventral surface. Head is often paler brown in front of brain, much deeper brown anteriorly next the white terminal border, and is brighter red in the brain region (both above and below), where the rosy coloring of this organ shows through the superficial darker brown color.

A series of very fine white rings encircles the body at intervals throughout most of its length. These rings occasionally show slight thickenings in the dorsal median line, but this is not usually the case. The first of these very narrow rings appears nearly as far behind the brain as is this organ from the tip of snout. The succeeding rings are commonly separated from each other by about the diameter of the body in ordinary states of contraction.

Anteriorly the rings usually encircle the whole body, but farther back they are merely indicated on ventral surface by very fine grayish lines of much less distinctness than on dorsal surface. In intestinal region they are sometimes separated by more than twice the diameter of body when moderately extended.

In some individuals the white rings are very indistinct, in others they are merely indicated on dorsal surface and are not present at all below, while they are wanting entirely in the posterior portions of the body. The fact that fission usually takes place through these white rings indicates that there must be some peculiarity of the body walls in these regions other than a lack or differentiation of pigment. This is true of other species of the genus and of other genera, notably *Carinella*. Body is often constricted at these points previous to rupture.

After preservation the delicate white rings disappear, and the body assumes a slaty black appearance, sometimes more grayish below, and with the distinct terminal white border.

Size.—Length commonly 7–15 cm.; width about 2–6 mm.

Body Walls.—Cephalic glands not well developed. Cutis glands limited to a rather thin but dense layer external to the outer longitudinal muscles. They do not encroach on this muscular layer to any great extent even in the intestinal region, nor do they sink in among the muscular fibers. The pigment to which the color of the body is due resides in the connective tissue among the cutis glands.

Nephridial and Blood Systems.—The nephridia are well developed, and extend through more than half the esophageal region. They reach anteriorly well toward the mouth, and send large branches among the esophageal lacunæ. In each of two specimens sectioned there was a single pair of large efferent ducts a little in front of the middle of the esophageal region. In another specimen a single accessory duct was found on one side, situated a considerable distance behind the normal pair and toward the posterior end of the nephridia. The single pair of efferent ducts is usually situated somewhat anterior to the middle of the nephridial region.

Cephalic and esophageal blood lacunæ large; numerous large blood lacunæ also surround the mouth. Proboscis sheath vessel leaves the rhynchocoel a little in front of the intestinal region.

Nervous system and sense organs show few deviations from those of related species. There is a large commissure of the esophageal nerves just in front of the mouth. The cephalic furrows are very deep and long. Frontal sense organs are present and well developed. They are situated in three well marked pits, of which one is situated above the

proboscis pore and one on each side, as in many related species, but are well separated from the proboscis pore.

Reproductive Organs.—Sexual products had evidently been recently discharged from specimens collected in August.

Habitat.—Common at Monterey, Calif., among kelp 'hold-fasts' attached to stones on sandy or rocky bottom in 2 fms. Pacific Grove, in crevices of rocks and under stones at low water. Dredged in several localities off San Pedro in 2 to 20 fms.

The species is named in honor of Prof. C. B. Wilson, of Westfield, Mass., well known for his work on Nemertean development, to whom I am indebted for several specimens of this and of other Nemerteans, and for valuable notes on a number of the species described in this paper.

22. MICRURA NIGRIROSTRIS sp. nov.

Pl. xvii, figs. 7, 8.

Body of small size, only moderately slender, rounded anteriorly, only slightly flattened in intestinal region; head commonly a little wider than parts immediately following; tip of snout rather narrow; cephalic slits of moderate length; mouth as usual, its anterior end situated opposite posterior ends of cephalic slits; proboscis long, flesh-colored. Caudal cirrus was not found in the few living individuals examined, but is probably present in uninjured individuals.

Color.—Dorsal surface of esophageal region bright blood-red; intestinal region of same color, but deeper, and sometimes with a tinge of purplish. Ventral surface of same color, but usually paler and duller in tone. Head of same blood-red color as esophageal region, with a narrow, but very sharp and conspicuous, transverse band of white near tip of snout. In ordinary states of contraction this white band is crescentic or V-shaped, its convex side pointing backward in the median line. It is a little wider laterally than in the middle, and is limited to the dorsal surface, only its ends showing from below. Immediately in front of this is a narrow, blood-red area bounded behind and laterally by the narrow white band, and in the middle of the red area, and situated on the exact tip of snout, is a small, rounded, dark brown or black spot. On this dark terminal spot are scattered a few minute whitish flecks. The brown or black spot is only slightly visible on ventral surface, as it lies a little more toward the dorsal than the ventral side of the exact tip of snout (Pl. xvii, figs. 7, 8).

Color after preservation brownish, but the narrow white ring near tip of snout and the terminal black or dark brown spot are still retained.

Ocelli.—None.

Size.—Length of the few individuals found 40–80 mm.; diameter about 2–3 mm.

Proboscis sheath extends to the posterior end of the body, and is well developed throughout. The circular muscles of the proboscis sheath increase to a remarkable degree near the posterior end of the stomach region, but the fibers do not extend beneath the alimentary canal as in several species described above. After reaching a great thickness at the posterior end of the stomach region they suddenly decrease to a very thin layer at the commencement of the intestinal region. It will be observed that although the fibers do not surround the alimentary canal, yet the thickening of the circular layer occurs in exactly the same region as in *L. rubescens* and other species, and is probably homologous with the inner circular muscles of those species.

Proboscis.—There are only two muscular layers present, the inner longitudinal muscles being completely wanting. Both the dorsal and ventral fibrous crossings between the circular muscles and the outer fibrous layer are well developed. A rather thick basement layer is situated between the nervous plexus and the inner epithelium. Another peculiarity of the proboscis in the single specimen sectioned is that there is a marked differentiation of the epithelium on one side throughout its whole length. This narrow strip of differentiated cells is quite conspicuous in each cross section, from the fact that in it the epithelium is much higher than elsewhere and behaves very differently to stains than do the other cells. This specialized area is composed of very slender cells, strongly resembling the sensory cells found in various parts of the body, and having numerous small nuclei among their bases.

Body Walls.—The cutis glands form a compact layer beneath the integument, and do not sink inward among the fibers of the outer longitudinal muscles as they do in many related species. Pigment which gives the brownish color to the body after preservation is situated in the connective tissue among the cutis glands.

Cephalic glands are well developed, and extend posteriorly nearly to the brain. Cephalic furrows are narrow, and are not deep. Except at their posterior ends, they reach less than half the distance from surface to rhynchodæum or brain.

Alimentary Canal.—The two divisions of the esophagus described for *Lineus rubescens*, *L. flavescens* and other forms are also well marked in the present species. The change from esophagus proper to stomach is abrupt, and the two sections are separated by a conspicuous sphincter of connective tissue. The position of this sphincter is at

about two-fifths the distance from snout to intestinal region, and is in the immediate vicinity of the efferent nephridial ducts. The histological peculiarities of the various portions of the alimentary canal have been described on previous pages for the two species mentioned above. The change from stomach to intestine is gradual, and the true intestinal pouches do not begin until after the appearance of a number of shallow pouches in the walls of the stomach.

Blood and Nephridial Systems.—The nephridia are very limited in extent, being confined to the posterior half of the esophageal region proper. Large nephridial tubules ramify among the esophageal blood lacunæ, and are collected into a main canal on each side. At the posterior end of this canal a single efferent duct passes to the exterior above the lateral nerves as usual. The nephridiopores are thus situated in the region where the esophagus opens into the stomach. The proboscis sheath vessel leaves the rhynchocœl at the same place. Here, too, the esophageal lacunæ unite into a pair of ventro-lateral vessels which pass back through the stomach region, and into which the lateral vessels empty at the beginning of the intestinal region. In the single specimen sectioned a pair of conspicuous longitudinal folds appear in the stomach epithelium immediately internal to the ventro-lateral vessels, and in many places the vessels themselves are situated within these folds.

Nervous System.—Brain and principal nerves as in related species. The median dorsal nerve is remarkably conspicuous throughout the length of the body. The internal median nerve, which rests on the dorsal side of the proboscis sheath, is also conspicuous. It is best developed in the stomach region.

Cerebral sense organs present no peculiarities.

Reproductive Organs.—Sexual products were not developed in individuals collected in August, and had evidently been discharged some time previously.

Habitat.—Among 'hold-fasts' of kelp and other algæ, low water to 2 fms., Dead Man's Island, San Pedro, Calif., not common; on floating kelp 'hold-fasts' off San Pedro Harbor, one specimen.

23. CEREBRATULUS ALBIFRONS Coe

Pl. xvii, fig. 9.

Proc. Wash. Acad. Sci., III, p. 82; Pl. IV, figs. 3, 4, 1901; also preceding article, which has identical paging.

Specimens collected in mud in San Pedro Harbor, California, measured upward of 30 cm. in length. Similar specimens were

dredged at several localities off San Pedro in 2 to 20 fms. In these individuals the coloring of the body, and the extent of the white terminal border on head were somewhat different from that described for the specimen from Alaska. The rather small mouth with its grayish lips was situated some little distance posterior to the white terminal border of head, and as far back as the posterior ends of the cephalic furrows.

Color of body was usually very dark, smoky brown, with a tinge of purple, but was sometimes almost black. A more reddish median line was indicated only when body was much extended. Lateral margins were not pale. Both dorsal and ventral surface of head pure white for about three-fourths the distance to posterior ends of cephalic furrows. Proboscis pinkish in color.

A single specimen belonging to this species was dredged in 50 fms. between San Pedro and Santa Catalina Island, Calif. This specimen was jet black in color except on the head, which had the characteristic white cephalic border exactly as here described.

The species has previously been recorded only from Sitka, Alaska (p. 85 of previous article), where a single specimen was found under a stone at low water. It is not uncommon in mud between tides in San Pedro Harbor, Calif.

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PLATE XIV

- FIG. 1. *Lineus rubescens* sp. nov. A large individual of the deep red variety. Pacific Grove, Calif. Enlarged five times. Compare figs. 3, 4, Pl. xv.
2. *Carinella cingulata* sp. nov. Mature female, containing ripe ova. Monterey Bay, Calif. Twice natural size.
3. *C. cingulata*. Anterior portion of body from ventral surface. Enlarged three times.
4. *C. cingulata*. Lateral view of anterior portion of body. Enlarged three times.
5. *Tetrastemma quadrilineatum* sp. nov. San Pedro, Calif. Ten times natural size.
6. *Tetrastemma bilineatum* sp. nov. San Diego, Calif. Ten times natural size.
7. *Tetrastemma* (*Ærstedtia*) *reticulatum* sp. nov. San Pedro, Calif. Ten times natural size.
8. *T. reticulatum*. Anterior portion of body of individual of the variety with confluent markings. Twelve times natural size.
9. *Tetrastemma signifer* sp. nov. San Pedro, Calif. Three times natural size.
10. *T. signifer*. Side view of head, showing position and extent of characteristic cephalic marking. Enlarged ten times.
11. *T. signifer*. Dorsal view of head, showing typical form of cephalic marking. Enlarged ten times.



PLATE XV

- FIG. 1. *Nemertopsis gracilis* sp. nov. Pacific Grove, Calif. Enlarged three and one-half times.
2. *Paranemertes californica* sp. nov. San Diego, Calif. Natural size.
3. *Lineus rubescens* sp. nov. Head of bright red variety with few ocelli. Monterey, Calif. Enlarged ten times. Compare fig. 1, pl. xiv.
4. *L. rubescens*. Head of pale, pinkish variety, with regularly arranged ocelli. San Pedro, Calif. Enlarged eight times.
5. *Carinella frenata* sp. nov. Mature female. The rosy color of dorsal surface in intestinal region is largely due to color of ova. San Pedro, Calif. Natural size.
6. *C. frenata*. Anterior portion of body after preservation in formalin. The body is strongly contracted, and shows the dark color which appears on body back of the third black ring after preservation. San Pedro, Calif. Twice enlarged.
7. *Tetrastemma nigrifrons* sp. nov. Variety *pallidum*. Monterey, Calif. Enlarged five times. Compare figs. 6-9, pl. xvi, and fig. 1, pl. xvii.



PLATE XVI

- FIG. 1. *Teniosoma punnetti* sp. nov. Caught on fishing-line by Chinamen, Monterey Bay, Calif. Somewhat less than natural size.
2. *T. punnetti*. Ventral side of head. Natural size.
3. *T. punnetti*. Ventral side of head when strongly contracted. Twice natural size.
4. *Carinella albocincta* sp. nov. Body somewhat contracted. Dredged between San Pedro and Santa Catalina Island, Calif., in 50-100 fathoms. Nearly twice natural size.
5. *C. albocincta*. Ventral side of head. Twice natural size.
6. *Tetrastemma nigrifrons* sp. nov. Anterior portion of body of the reddish variety. Monterey, Calif. Enlarged seven times. Compare fig. 7, pl. xiv, fig. 1, pl. xvii.
7. *T. nigrifrons*. Ventral side of head. Enlarged seven times.
8. *T. nigrifrons*. Variety *bicolor*. Monterey, Calif. Enlarged four times. Compare fig. 7, pl. xiv, fig. 1, pl. xvii.
9. *T. nigrifrons*. Variety *bicolor*. Ventral side of head.
10. *Lineus wilsoni* sp. nov. Pacific Grove, Calif. Slightly enlarged. In the process of reproduction this drawing has made the body of the worm to appear much too uneven and irregular both in outline and color.
11. *L. wilsoni*. Side view of head. Twice natural size.

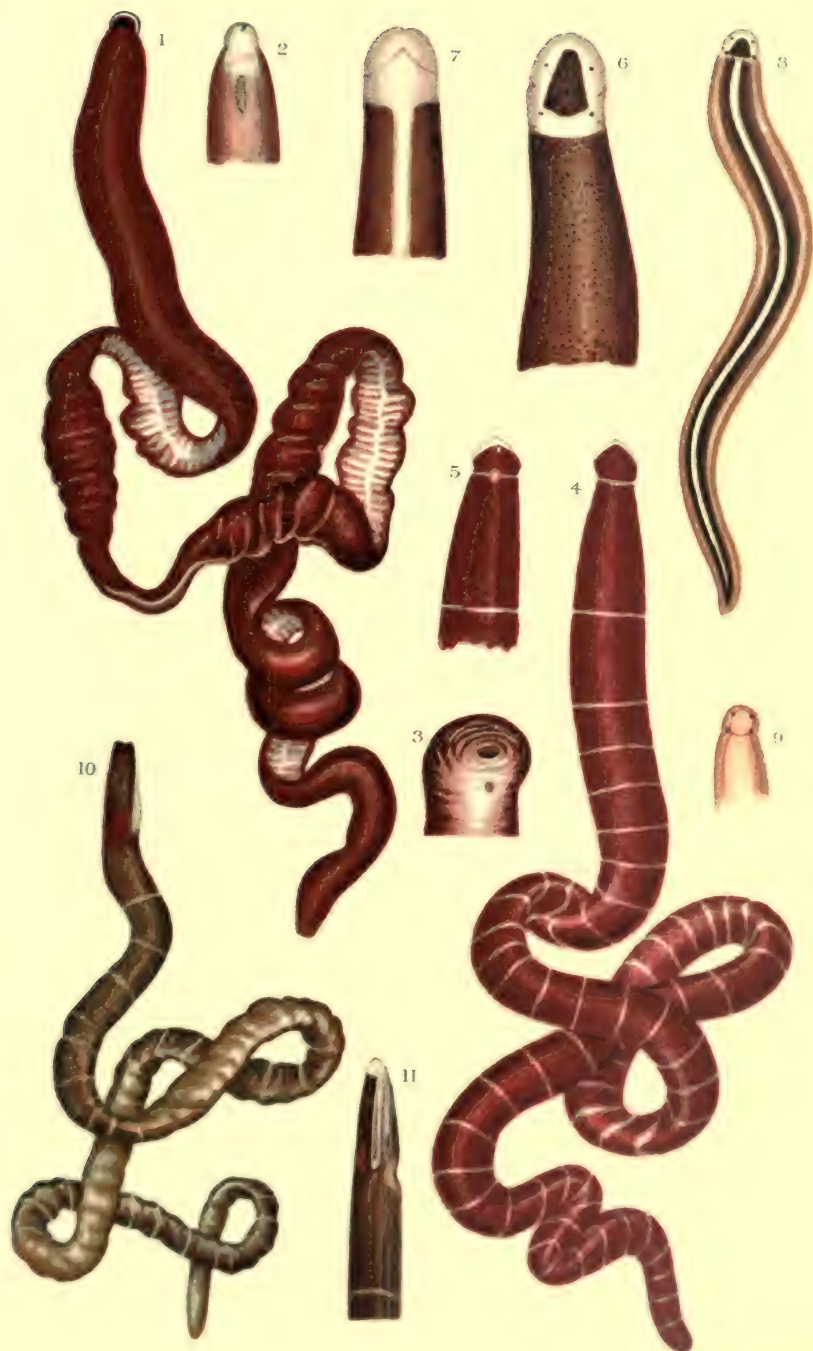






PLATE XVII

- FIG. 1. *Tetrastemma nigrifrons* sp. nov. Variety *purpureum*. Dorsal side of anterior portion of body; head much contracted. Monterey, Calif. Enlarged five times. Compare fig. 7, Pl. XIV, figs. 6-9, Pl. XVI.
2. *Lineus albolineatus* sp. nov. Dorsal side of anterior portion of body. Dredged in thirty fathoms off Point Fermin, near San Pedro, Calif. Enlarged four times.
3. *Lineus flavescens* sp. nov. Dredged in fifty fathoms between San Pedro and Santa Catalina Island, Calif. Enlarged three times.
4. *L. flavescens*. Dorsal view of anterior portion of body showing arrangement of ocelli, position of ganglia, and the two portions of esophageal region. Enlarged ten times.
5. *Lineus pictifrons* sp. nov. Large individual. San Pedro, Calif. Enlarged one and one-half times. The longitudinal yellow lines are extremely delicate (and sometimes entirely wanting) in life, and appear much too distinct in this figure.
6. *L. pictifrons*. Dorsal surface of head. Enlarged three times.
7. *Micrura nigrirostris* sp. nov. San Pedro, Calif. Enlarged five times.
8. *M. nigrirostris*. Ventral side of anterior portion of body. Enlarged five times.
9. *Cerebratulus albifrons* Coe. Ventral side of anterior portion of body. San Pedro Harbor, Calif. Natural size.





PLATE XVIII

FIG. 1. *Paranemertes californica* Coe. Transverse section of body a short distance behind brain, showing the two distinct layers of longitudinal muscles (*lm* and *lm'*) of body walls separated by a thick layer of parenchyma (*par*). Numerous anastomosing blood vessels (*bv*) are imbedded in this layer of parenchyma, as well as in that lying internal to the inner longitudinal muscular layer; *bm*, basement layer; *ln*, lateral nerve; *e*, esophagus; *i*, integument; *rc*, rhynchocœl. $\times 30$.

FIG. 2. *P. californica*. Transverse section of proboscis through basis of central stylet. The section shows the six pouches of accessory stylets symmetrically arranged between the outer and inner longitudinal muscular layers (*olm* and *ilm*). The space between the stylet pouches is closely packed with large gland cells (*gl*) filled with deeply staining secretion. In the center of the proboscis, surrounded by the radially disposed bundles of the inner longitudinal muscles, is a section of the basis of the central stylet (*a*), and to the right of this a section of the duct (*x*) leading from the middle to the anterior chamber of the proboscis; *oep*, outer epithelium of proboscis. $\times 90$.

FIG. 3. *P. californica*. Longitudinal, and nearly horizontal, section of body walls in the region of the intestinal cœcum, the lateral diverticula of which (*ic*) are arranged with great regularity in the parenchyma immediately internal to the lateral nerve (*ln*). A thick layer of parenchyma (*par*) lies between the diverticula of the intestinal cœcum and the muscular walls (*lm'* and *cm'*) of the proboscis sheath; *bv*, blood vessels; *ln*, lateral nerve; *lm*, longitudinal muscles; *cm*, circular muscles; *bm*, basement layer; *i*, integument. $\times 30$.

FIGS. 4, 5. *P. californica*. Central stylets and bases (see pl. XXI, figs. 3-5). $\times 90$.

FIG. 6. *Tyzniusoma punnetti* Coe. Lateral view of anterior portion of body after clearing in cedar oil, showing distribution of the numerous small ocelli immediately ventral to dark marking on snout, which is marked off from succeeding portion of head by an annular constriction. The mouth (*m*) is indicated. $\times 8$.

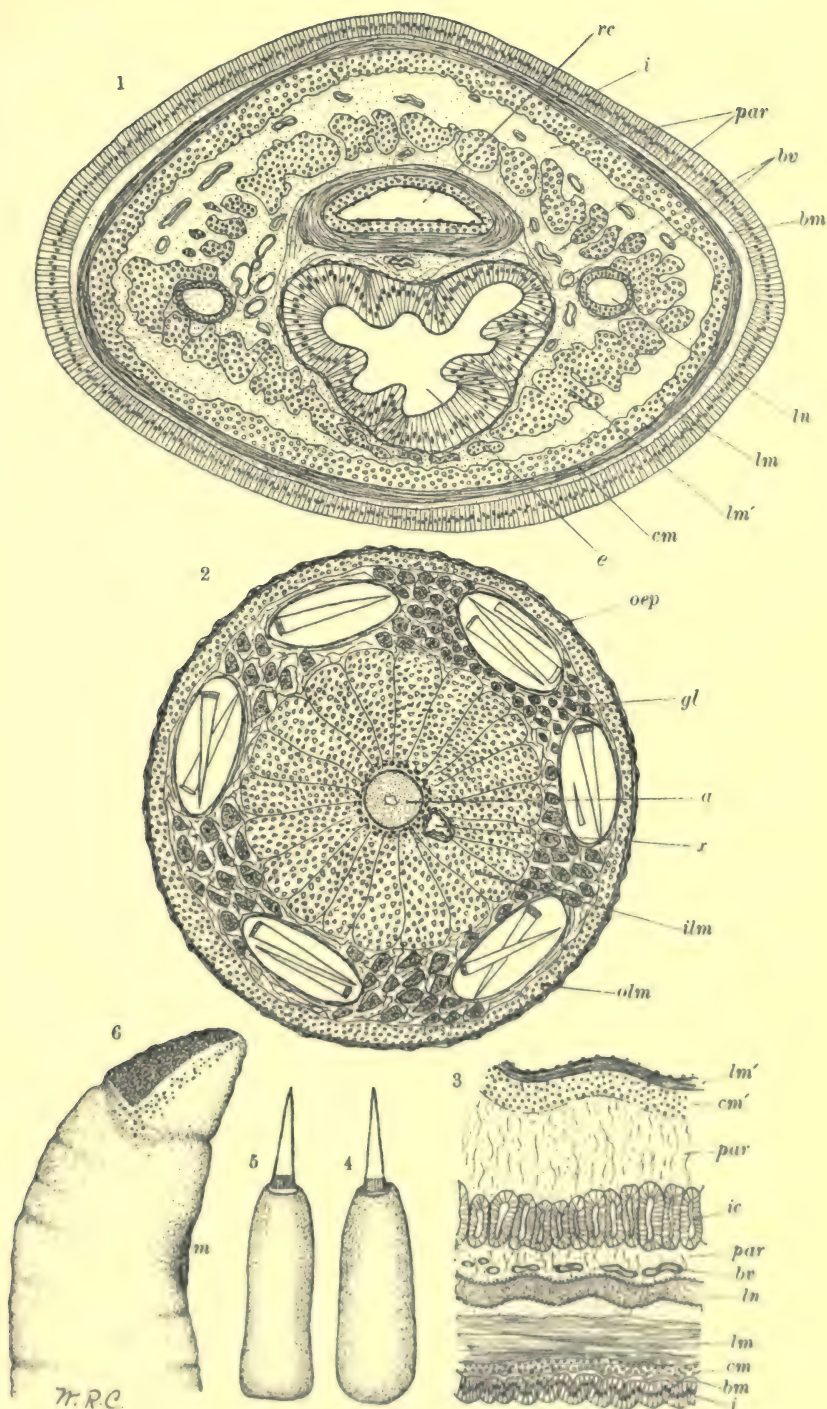


PLATE XIX

FIG. 1. *Carcinonemertes epialti* Coe. Diagram of body, showing ocelli, brain lobes, alimentary canal (in dotted lines) and genital glands. $\times 15$.

FIG. 2. *C. epialti*. Optical section of proboscis removed from the worm; *ac*, *mc*, *pc*, anterior, posterior, and middle chambers respectively; *g*, gland cells; *c*, canal connecting anterior and middle chambers; *ps*, remnants of proboscis sheath attached to posterior chamber; *ct*, connective tissue in which posterior chamber is imbedded; *b*, basis of central stylet. $\times 225$.

FIG. 3. *C. epialti*. Horizontal section of proboscis lying between the brain lobes (*br*) in its natural position, and showing the posterior chamber lying at right angles to the general axis of the proboscis. Reference letters as in fig. 2. $\times 225$.

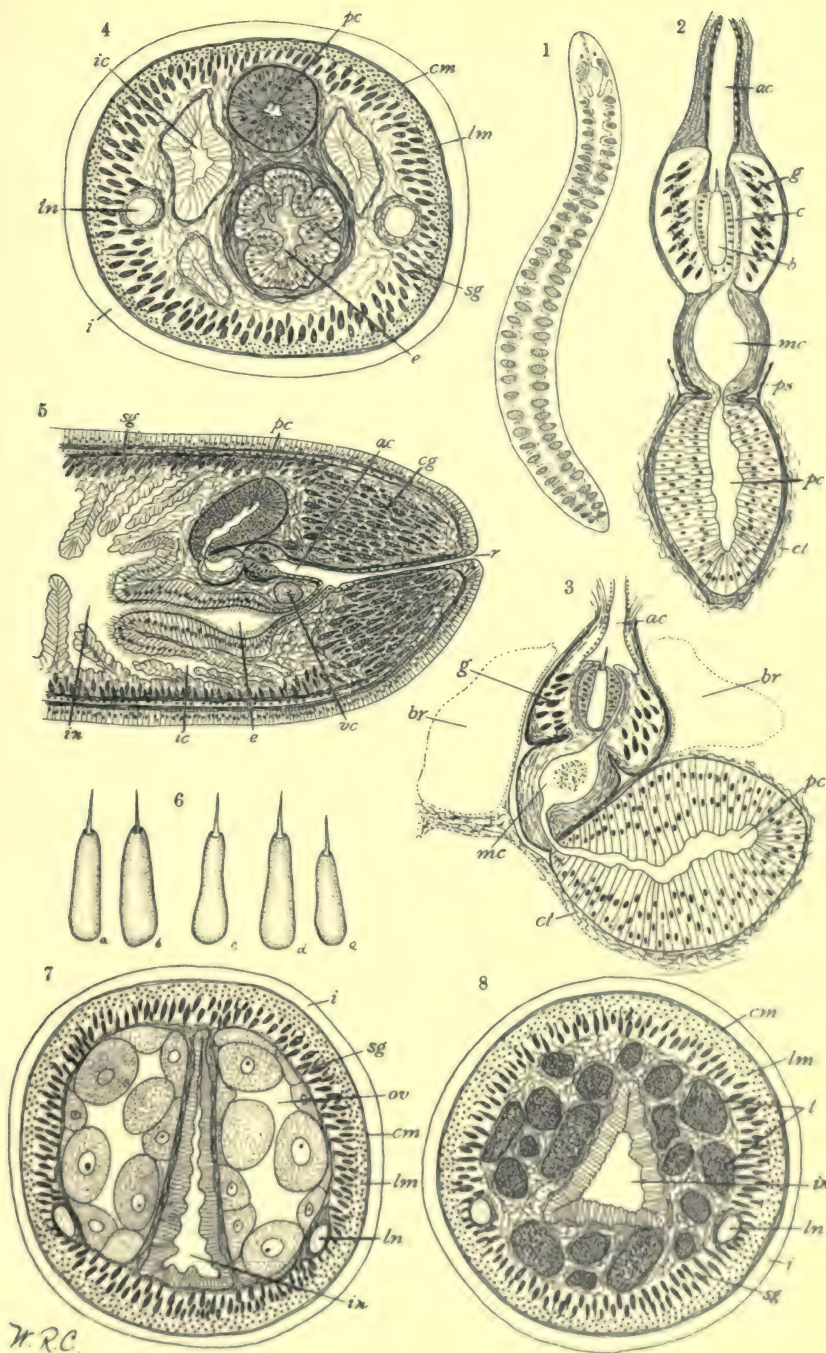
FIG. 4. *C. epialti*. Transverse section of body immediately back of brain. The posterior chamber of the proboscis (*pc*) is firmly imbedded in the surrounding connective tissue. Three lobes of the very short intestinal cæcum (*ic*) are seen; *e*, esophagus lined with cilia; *cm*, *lm*, circular and longitudinal layers of muscles; *sg*, submuscular glands; *ln*, lateral nerve; *i*, integument. $\times 150$.

FIG. 5. *C. epialti*. Oblique section through anterior portion of body; *r*, opening of rhynchodæum; *cg*, cephalic glands; *ac*, *pc*, anterior and posterior proboscis chambers; *sg*, submuscular glands; *vc*, ventral commissure of brain; *e*, esophagus; *ic*, rudimentary intestinal cæcum; *in*, intestine. $\times 125$.

FIG. 6. *C. epialti*. Several stylets with their bases, showing variations in form and size. $\times 400$.

FIG. 7. Transverse section of body of *C. epialti*, showing the thick layer of submuscular glands (*sg*) and the ovaries (*ov*) with large ova. The intestine (*in*) is reduced to a narrow canal. Other reference letters as in fig. 4. $\times 150$.

FIG. 8. *C. epialti*. Transverse section of body, showing the large number of spermaries (*s*) and their distribution through the body parenchyma. Reference letters as in fig. 4. $\times 150$.



W.R.C.

COE, DEL.

HELIOTYPE CO.

PLATE XX

FIG. 1. *Amphiporus cruentatus* Verrill. Optical section of stylet apparatus of proboscis after extrusion. To the right of the basis is seen duct leading forward from middle to anterior proboscis chamber. $\times 220$.

FIGS. 2-5. *A. cruentatus*. Outlines of central stylets and bases, showing variation in size and form in different individuals. $\times 220$.

FIG. 6. *A. cruentatus*. Outline of head, showing comparative size and position of ocelli. $\times 30$.

FIG. 7. *Tetrastemma reticulatum* Coe. Optical section of stylet apparatus of proboscis. $\times 220$.

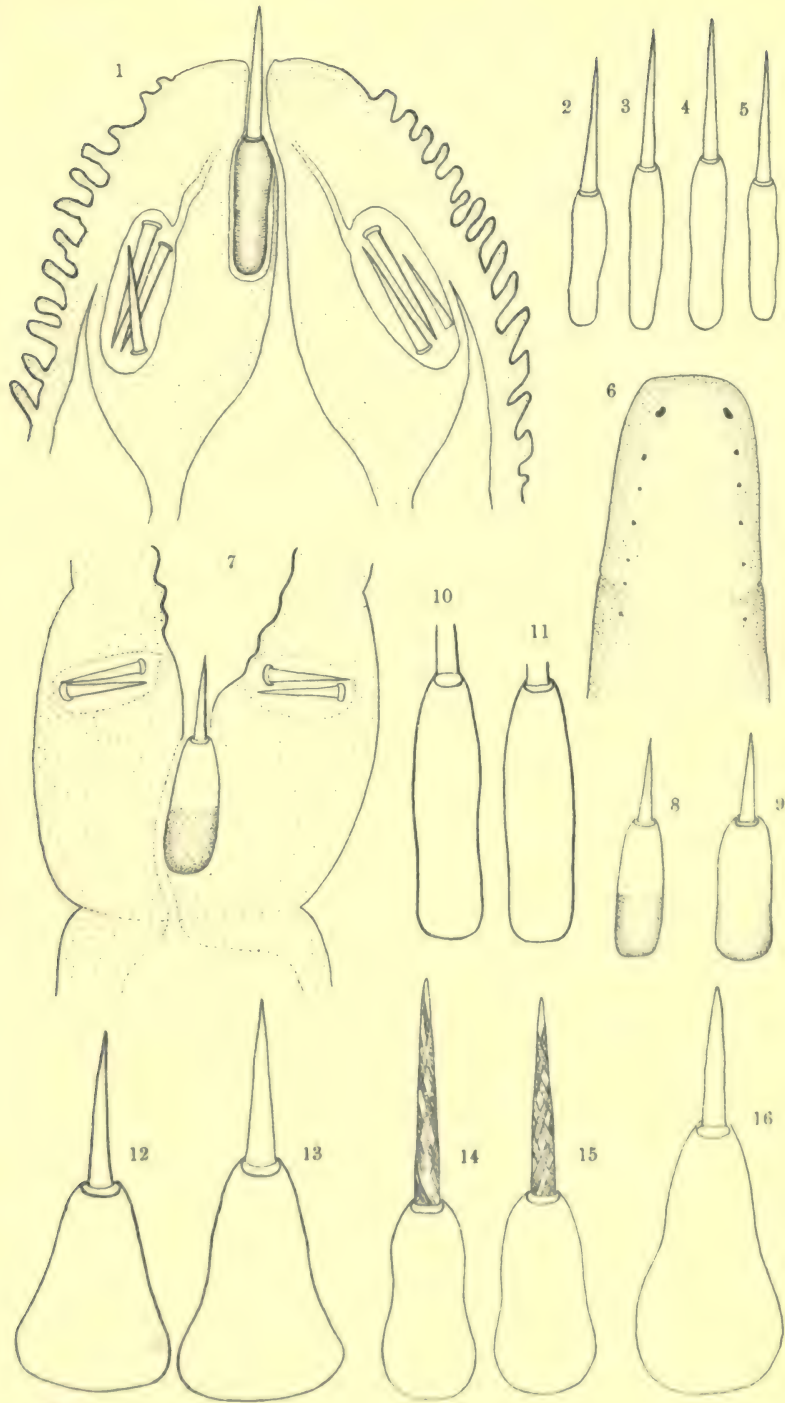
FIGS. 8, 9. *T. reticulatum*. Outlines of central stylets and bases in two individuals. $\times 220$.

FIGS. 10, 11. *Nemertopsis gracilis* Coe. Outlines of bases of central stylets in two individuals. $\times 300$.

FIGS. 12, 13. *Tetrastemma quadrilineatum* Coe. Outlines of central stylets and bases in two individuals. $\times 430$.

FIGS. 14, 15. *Paranemertes peregrina* Coe. Outlines of central stylets and bases, showing the peculiar braided appearance of stylet. Both central and accessory stylets present this peculiarity. The braided appearance is probably due to a deep spiral fluting, the translucence of the stylets allowing the flutings of both upper and lower surfaces to appear as if actually crossing. $\times 300$.

FIG. 16. *Tetrastemma nigrifrons* Coe. Outline of central stylet and basis (see Pl. XXI, figs. 15-23). $\times 220$.



H.R.C.

PLATE XXI

FIG. 1. *Paranemertes californica* Coe. Dorsal view of anterior portion of body, showing position of the two small ocelli on tip of snout. Position of cephalic furrows indicated by dotted lines; *br*, brain; *ln*, lateral nerve. $\times 12$.

FIG. 2. *P. californica*. Dorsal view of tip of snout, showing the two fragmented ocelli. $\times 12$.

FIG. 3. *P. californica*. Stylet apparatus of proboscis, showing central stylet and basis and four pouches of accessory stylets. $\times 45$.

FIGS. 4-8. *P. californica*. Central stylets and bases from five individuals, showing variations in size and shape. $\times 90$.

FIG. 9. *P. californica*. Accessory stylets more highly magnified, showing the peculiarly striated basal portion of each. The central stylets in figs. 4-8 are perfectly similar to these. $\times 220$.

FIGS. 10-12. *Tetrastemma signifer* Coe. Central stylets and bases from three individuals. $\times 220$.

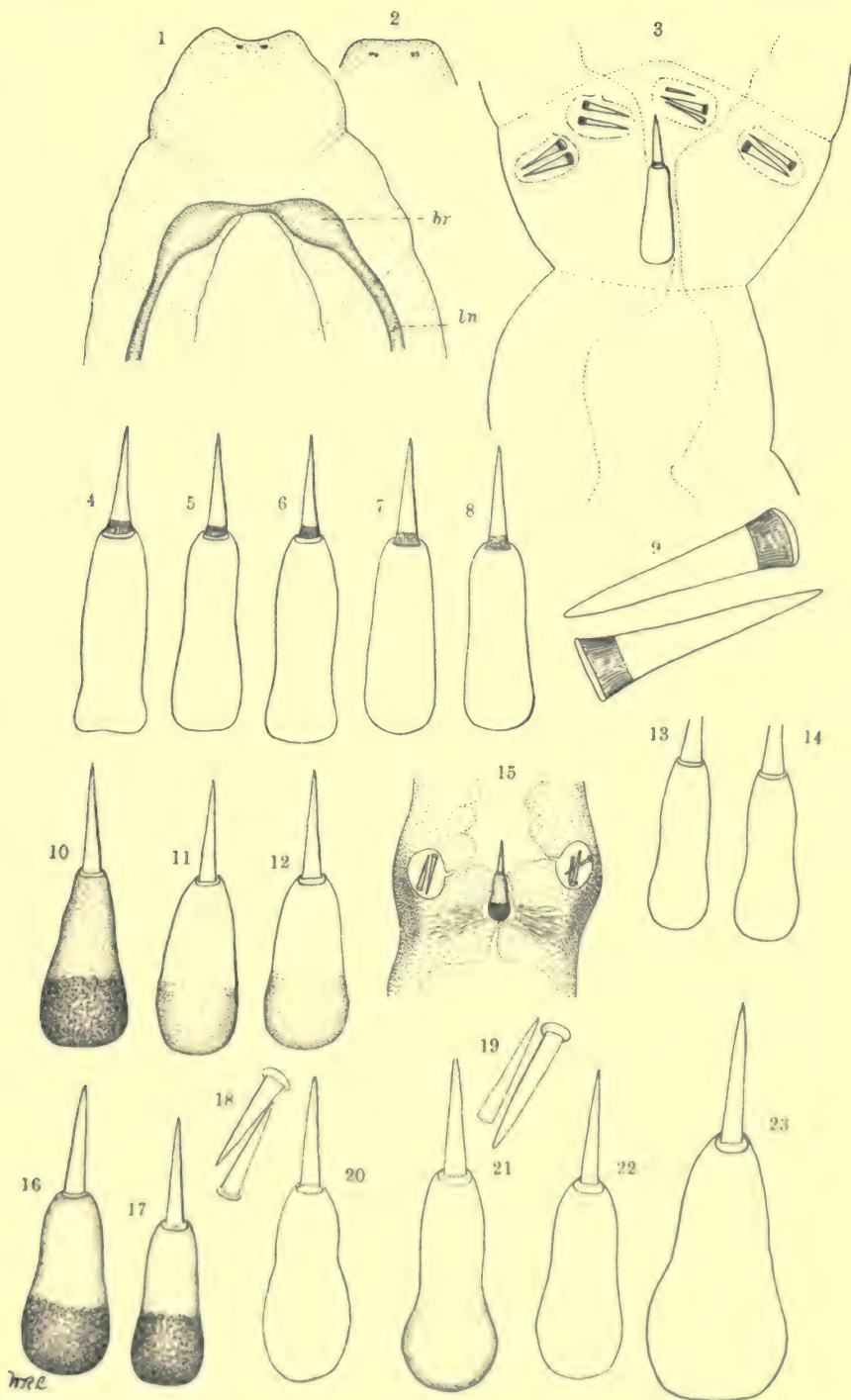
FIGS. 13-14. *T. bilineatum* Coe. Outlines of bases of central stylets. $\times 380$.

FIG. 15. *T. nigrifrons* Coe. Stylet apparatus of proboscis. $\times 50$.

FIGS. 16-17. *T. nigrifrons* Coe. Central stylets and bases, showing more opaque posterior portions. $\times 180$.

FIGS. 18-19. *T. nigrifrons*. Outlines of accessory stylets. $\times 220$.

FIGS. 20-23. *T. nigrifrons*. Outlines of central stylets and bases, showing variation in form and size. Figs. 20-22 from very small individuals; fig. 23 from the largest specimen collected. $\times 220$.



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COE, DEL.

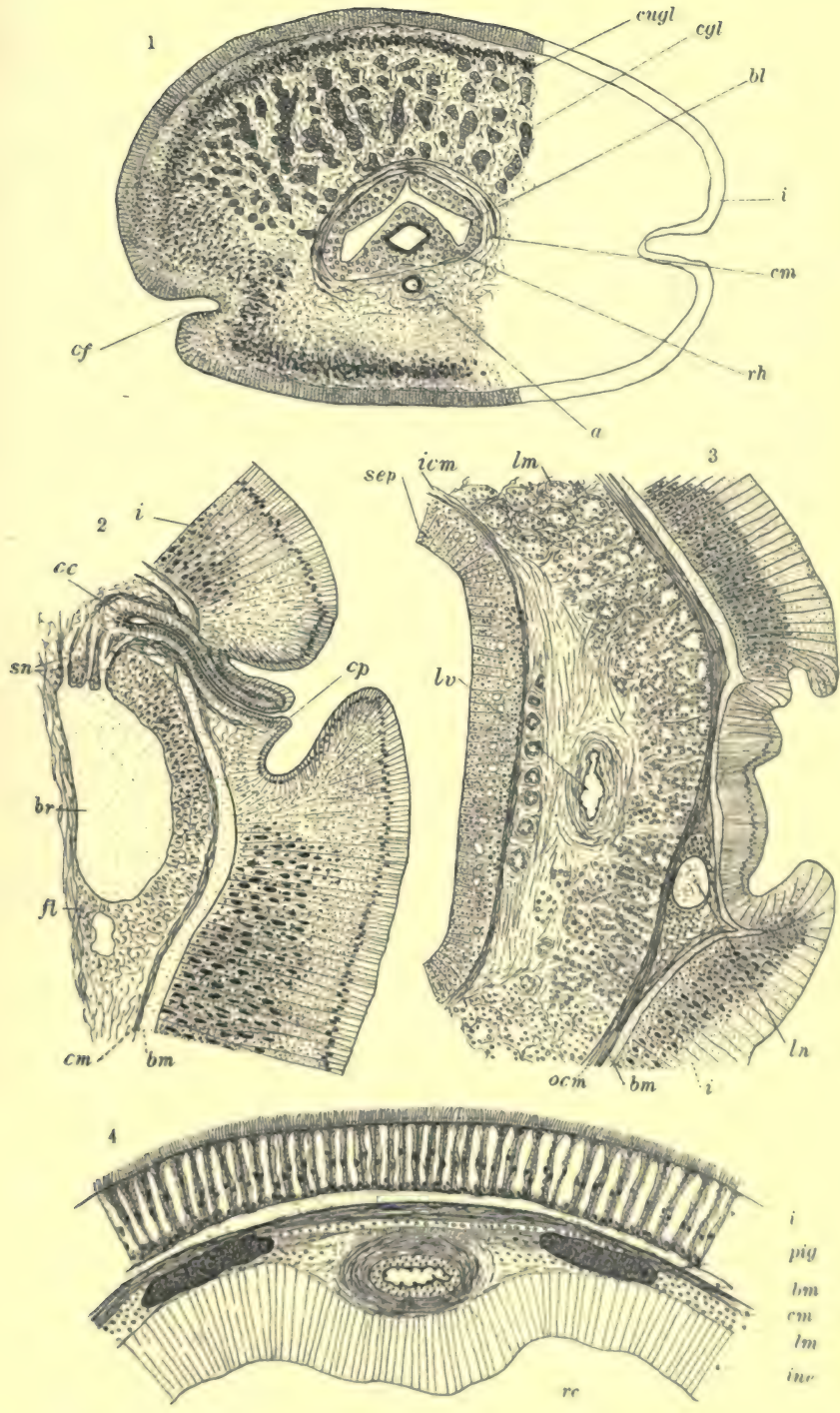
PLATE XXII

FIG. 1. *Lineus rubescens* Coe. Transverse section of head in front of brain, showing distribution of cutis glands (*cugt*), the highly developed cephalic glands (*cgl*), and the duct (*a*) leading forward beneath the rhynchodæum (*rh*). This duct is probably the common efferent canal for the secretions of the more posterior cephalic glands; *cf*, cephalic furrow; *bl*, blood lacuna; *cm*, circular muscles. $\times 80$.

FIG. 2. *Carinella frenata* Coe. Portion of transverse section of head, showing the deep ciliated pit (*cp*) from which a ciliated sensory canal (*cc*) leads inward to the brain region, where it becomes surrounded with sensory nerves (*sn*) from the dorsal side of brain to form a highly specialized sense organ; *i*, integument; *fl*, layer of fibrous connective tissue surrounding brain; *cm*, circular muscles; *br*, fibrous core of brain, surrounded except internally by a thick layer of nerve cells; *bm*, basement membrane. $\times 60$.

FIG. 3. *Carinella frenata*. Portion of transverse section of body through lateral sense organ; *i*, integument, sharply contrasted with the layer of specialized sensory cells lining the sensory pit; *ln*, lateral nerve; *lv*, lateral blood vessel; *sep*, epithelium of stomach; *icm* and *ocm*, inner and outer circular muscular layers; *lm*, longitudinal muscles. $\times 60$.

FIG. 4. *Tetrastemma bilineatum* Coe. Portion of transverse section of body. The two pigment bands (*pig*) which give the body its characteristic markings are situated in the midst of the longitudinal muscles (*lm*), on either side of the proboscis sheath (*rc*); *ine*, intestinal epithelium; other reference letters as in fig. 2. $\times 230$.



THE BRYOZOA OF THE
EXPEDITION

The following paper on the Bryozoa of the Expedition, by Miss Alice Robertson, of the University of California, was originally published in the Proceedings of the Washington Academy of Sciences, vol. II, pp. 315-340, Oct. 10, 1900. It is here reprinted from the same electrotpe plates, so that it may be quoted exactly as if it were the original. The original pagination has been preserved and transferred to the inner or hinge side of the page, where it is enclosed in brackets, thus [316]; while the consecutive pagination of the present volume has been added in the usual place. In the plates the original number and running headline, slightly abbreviated, have been preserved [in brackets], while the volume designation and serial plate number have been added in the usual place. The original text references to the plates are unchanged. The present headpiece and title have been substituted for the running heading of the Academy's Proceedings and the original title, which was: *Papers from the Harriman Alaska Expedition. VI. The Bryozoa.* No other alterations have been made.

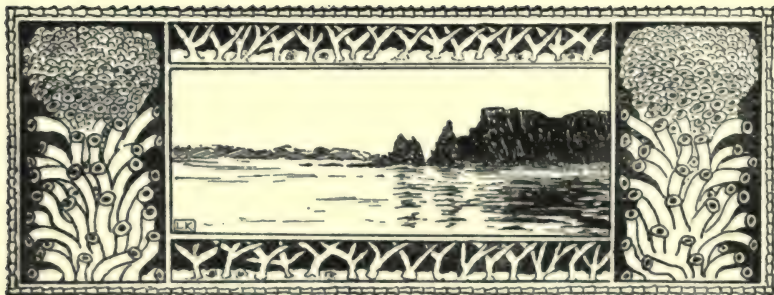
The author desires to record the following corrections:

Page 240 [332], fourth line from top, for 'Ballyell' read *Dalyell*.

Page 242 [334], second line from bottom, for 'Filaridan' read *Floridan*.

Throughout the paper, wherever the words 'zæcia,' 'zæcium,' 'zæcial,' 'æcia,' and 'æcium' occur, insert *o* before the diphthong.

EDITOR.



THE BRYOZOA OF THE EXPEDITION

BY ALICE ROBERTSON

THE following report is based on the Bryozoa obtained by Professor W. E. Ritter, of the University of California, while in Alaska as a member of the Harriman Alaska Expedition during the months of June and July, 1899. The localities at which collections were made are: Muir Inlet, Garforth Island, Sitka, Juneau, Yakutat Bay, Prince William Sound, Kadiak, and Fakir Islet. There are in all thirty-seven species, five of which are new. These contain representatives of the three divisions of the Ectoprocta, one of the Entoprocta, and one of the fresh-water forms. I have adopted the system of classification which is given by Hincks ('80). As may be seen by perusal of the list of species, the Bryozoan fauna of Alaska is essentially arctic, consequently the work of Smitt ('65-'68), who has made such a complete study of northern forms, has been of invaluable assistance. In order not to crowd the text unnecessarily, and at the same time to make clear what form is intended, the synonymy includes, as a rule, only the specific names of these two writers, and the foreign distribution is given mainly upon their authority.

The only work which has heretofore been published on the Bryozoa of Alaska waters is that of Mr. Hincks in the report on the Polyzoa of Queen Charlotte Islands ('82-'84). Many species are common to Alaska, Queen Charlotte Islands, Puget Sound, and California, and under local distribution I have included all the localities on the western coast of North America, where I know, either from personal knowledge, or on the authority of others, that a particular species exists.

Class **BRYOZOA** Ehrenberg.

Group **ECTOPROCTA** Nitsche.

Order **GYMNOLÆMATA** Allman.

Suborder **CHEILOSTOMATA** Busk.

Family **EUCRATIIDÆ**.

GEMELLARIA Savigny.

GEMELLARIA LORICATA Linnæus.

Gemellaria loricata HINCKS ('80), pl. III, figs. 1-4.

Gemellaria loricata SMITT ('67), pl. XVII, fig. 54.

Habitat.—Very abundant on the rocks at low tide.

Local distribution.—Juneau, 20 fms.; Orca, Prince William Sound; Yakutat; Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Scandinavia; Spitzbergen, 3-10 fms.; Greenland; Hammerfest; Havörsund; Labrador; St. George Banks, 50-85 fms.; White Sea; Ostend; Britain, from littoral region to deep water, 80 fms.

Family **CELLULARIIDÆ**.

MENIPEA Lamouroux.

MENIPEA TERNATA Ellis & Solander.

Menipea ternata HINCKS ('80), pl. VI, figs. 1-4.

Cellularia ternata SMITT ('67), pl. XVI, figs. 10-14.

Habitat.—In considerable quantity growing with *Bugula* upon *Styela* and upon the rocks.

Local distribution.—Yakutat, Puget Sound; Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Spitzbergen, chiefly in the littoral region; Hammerfest; Lofoten; White Sea; Jütland, 10 fms.; Belgium; Great Britain.

As compared with specimens from Northumberland, England, those from the Pacific Coast are stouter and more vigorous. By measurement the internodes are found to be shorter and slightly wider. Thus, in the Yakutat form the average length of an internode consisting of three zœcia is 42 mm., its width from tip to tip of the avicularia 33 mm.; in the English form the length of an internode is 52 mm., its width 28 mm.

MENIPEA TERNATA Ellis & Solander.

B. forma *gracilis* SMITT ('67), pl. xvi, figs. 16-24.

Habitat.—In considerable quantity on the rocks at low tide.

Local distribution.—Orca, Prince William Sound. This elongated form of *Menipea ternata* is also reported from Cumshewa Harbor, Queen Charlotte Islands.

Foreign distribution.—Spitzbergen at 200 fms.; Franklin-Pierce Bay; Barents Sea.

The zœcia of this species are very much elongated, and internodes consisting of three zœcia range from 60 to 90 mm. in length. Many internodes, however, consist of five or seven zœcia, and it is upon these that the æcia seem to occur. The avicularia, both lateral and frontal, may be present or absent. In many instances in which an internode consists of more than three zœcia, a frontal avicularium appears below the aperture of each. In such cases, lateral avicularia are sparingly developed. One may be found on the lower zœcia, but not, as a rule, upon all. When æcia occur, they fill that portion of the next upper zœcium which is below the aperture, and the frontal avicularia occupy a narrow space between the æcium and the edge of the aperture. In some cases they seem to be sessile upon the æcia.

MENIPEA ERECTA sp. nov.

(Pl. XIX, figs. 1, 2.)

Habitat.—On an ascidian.

Local distribution.—Sitka, Alaska, 10 fms.

Zoarium dichotomously branched, internodes usually consisting of 5 to 7 zœcia. Zœcia biserial, alternate, narrowed below; aperture (fig. 1, *ap.*) broadly ovate, occupying two-thirds of the front; margin (*m.*) raised, crenulate, with two blunt spines (*sp.*) on the upper outer angle; operculum (*op.*) a flattened spine; sometimes growing broad, when it is frequently more or less bifid. Lateral avicularia wanting; frontal avicularia (*f. a.*) few. Æcia (*æ.*) large, globose,

more or less striated. Radical fibers (fig. 2, *r.f.*) developed mainly upon the lower zœcia.

The general habit of this colony resembles that of *Scrupocellaria*. The branches are very calcareous and erect, tending to flare outward. They differ in this respect from the preceding species whose branches curl inward. The number of zœcia in an internode is five or seven as a rule, but there is considerable variation in this regard. Toward the middle of a branch the number increases and 9, 11, or 13 are frequently found. In one case 21 zœcia occur before the internode bifurcates. On the lowest one or two zœcia of a colony, very small lateral avicularia may sometimes be detected. Frontal avicularia appear only at infrequent intervals. The zœcium situated at the bifurcation of a branch usually possesses one below the aperture (fig. 1, *ap.*). They appear occasionally upon other zœcia also, but no constancy is maintained.

This species is closely allied to *M. duplex* Smitt ('67), and to *M. jeffreysii* Norman ('68), in its habit of growth. There are differences in zœcial characters, however. Comparing pl. xix, fig. 1, with pl. xvi, fig. 25, Smitt ('67), it will be seen that this form differs from *M. duplex* in its possession of opercula and spines, and in its lack of avicularia. In comparison also with the original drawing, Norman ('68), or with the figures given by Hincks ('80) it differs from *M. jeffreysii* in the number of spines, in the lack of avicularia, and in the very different shape and inclination of the opercula.

SCRUPOCELLARIA Van Beneden.

SCRUPOCELLARIA SCABRA Van Beneden.

(Pl. XIX, figs. 3, 4.)

Scrupocellaria scabra HINCKS ('80), pl. vi, figs. 1, 2. HINCKS ('89), pl. xxi, fig. 1.

Cellularia scabra SMITT ('67), pl. xvii, fig. 29.

Habitat.—Growing entangled in seaweed.

Local distribution.—Kadiak.

Foreign distribution.—British coast; North Sea; Scandinavian and Arctic seas; Spitzbergen; Davis Strait; Greenland; Reykjavik Harbor; Madeira. Form without vibracula: Greenland; St. Lawrence.

The form of *S. scabra* which occurs in this collection lacks all traces of vibracula. These structures are usually considered a characteristic mark of this genus, nevertheless there seems to be sufficient reason for placing it here, at least provisionally.

The habit of growth is decidedly scrupocellarian. The branches are stiff and calcareous, and the internodes rather long, varying from 3 or 5 in the lower part of a colony, to 12 or 15 in the upper. Both lateral and frontal avicularia are developed upon each zœcium and are of large size (fig. 3, *lat. f.a.*). On those internodes where œcia (*œ.*) occur the frontal avicularia are pushed to one side and form an irregular line between the two series of cells. Commonly but one spine (*sp.*) is developed at the upper outer angle. The opercula (*op.*) vary from a simple, spinous process to a broad, sub-triangular structure marked with the peculiar hand-like sculpturing which characterizes this species. The zœcium which is situated at the bifurcation of a branch possesses a short spine at the top, and in the particular case represented, the aperture is partially covered by two opercula instead of an operculum and a spine, as is the usual case (*op.*, *op'*). In comparison with a specimen from Norway, the appearance of the colony is more robust, the spines are shorter and thicker, and the zœcia slightly longer and broader. Fig. 4 represents the dorsal surface. Upon the zœcia of the lower portion of the colony, radical fibers are developed, but no vibracula are visible.

According to Mr. Hincks, vibracula are of uncertain occurrence in this species. Such as are found are of a rudimentary character, and he remarks: "They are commonly wanting on many of the cells." It is possible that in a larger quantity of material some zœcia may be found upon which vibracula or traces of such structures are present. This form differs from the normal in this one particular only. Both Hincks and Jullien ('82) have described as *S. scabra* a form which not only lacks vibracula, but differs from the type in other important respects, and for the present I shall be guided by the precedent they have set.

CABEREA Lamouroux.

CABEREA ELLISII Fleming.

Caberea ellisii HINCKS ('80), pl. VIII, figs. 6-8.

Caberea ellisii SMITT ('67), pl. XVII, figs. 55-56.

Habitat.—Found growing on a shell dredged at 20 fms.; obtained also on the rocks at low tide.

Local distribution.—Juneau; Orca, Prince William Sound; Cumshewa Harbor, Queen Charlotte Islands; Vancouver Island.

Geographical distribution.—Labrador and Maine; St. George Banks, 28-150 fms.; Greenland, 100 fms.; Iceland, 15-20 fms.; Scandinavia and Finmark, 50-80 fms., not uncommon; Shetland, 40-70 fms., abundant; Orkneys; off the coast of Antrim, 62-72 fms.

Family *BICELLARIIDÆ*.**BUGULA** Oken.**BUGULA MURRAYANA** Johnston.

Bugula murrayana HINCKS ('80), pl. XIV, figs. 2-9.

Bugula murrayana SMITT ('67), pl. XVIII, figs. 19-22.

Habitat.—Abundant on the rocks.

Local distribution.—Orca, Prince William Sound; Juneau; Houston-Stewart Channel and Virago Sound, Queen Charlotte Islands; Puget Sound, dredged.

Geographical distribution.—Scandinavian coasts; Grötsund, Finland, 100 fms.; Spitzbergen; Greenland; Labrador; Gulf of St. Lawrence; New England; St. George Banks; North Sea; Orkneys; Shetland; coast of Britain.

Compared with specimens from the Northumberland coast, England, the Orca form attains a very strong and vigorous growth. The normal type prevails, but differs from the English form in the greater opaqueness of the zœcial walls and in the size and greater abundance of the spines. A variety also occurs which is extremely flustrine in appearance. The segments are short and broad, often possessing 18 to 24 zœcia in alternate rows, and they spread out from the center forming a fan-like growth. In all essential marks, size and number of spines, position and size of avicularia and zœcia, shape of zœcia, etc., this variety agrees with the typical form.

BUGULA PURPUROTINCTA Norman.

(Pl. XX, figs. 5. 6.)

Bugula purpurotincta HINCKS ('80), pl. XII, figs. 8-12.

Bugula purpurotincta NORMAN ('68).

Habitat.—Very abundant upon *Styela* and upon the rocks.

Local distribution.—Yakutat Bay; Orca; Pribilof Islands; Puget Sound; Tomales Bay, California.

Foreign distribution.—Rather abundant on the northern coasts of Britain; Christiansund; Bejan, 40-60 fms.; Lofoten; Bahusia; Norway, common, 30-130 fms.; St. George Banks, 110-115 fms.

This species grows in large bushy tufts often 7.5 cm. in height, and the colonies are frequently united by a sort of cable formed by the radical fibers. It is remarkable not only for its luxuriant growth but also for the rich purple which most of it displays in the living as well as in the dried condition. The color is particularly noticeable in that

which was obtained at the Point, in the more exposed situation. It is located in part in the tissue lining the zœcia, and in part in the degenerated polypides. These constitute the so-called 'brown bodies' of other Bryozoa which in this species are purple. A small number of specimens was picked up at the Pribilof Islands, Alaska, by Professor Kincaid, of the Washington University. These have been preserved in the dried state and the color is very distinct. Material obtained at other points near Yakutat, and some of the same, or of a closely allied species, from Puget Sound and California, do not show this color, but are rather of a yellowish tinge.

In some respects this species varies from the type described by Norman and Hincks. Thus, these authors report but one spine for *Bugula purpurotincta*, and a denticle in front of it. The Yakutat form possesses three spines and the number seems to be invariable. As represented in Pl. XX, fig. 5, a long spine (*sp.*) is present at the summit of the zœcium. This probably corresponds to the one reported for this species. But at the upper extremity of the aperture, structures occur on each side, which may properly be called spines (*sp.* ' *sp.* '), one of which may perhaps correspond to the denticle of the English form. The long spine (*sp.*) at the top of the zœcium frequently measures 15 mm., while the other two are smaller, measuring on an average about 5 mm. The aperture (*ap.*) is long, and extends almost to the bottom of the zœcium. The avicularia (*av.*) are of unusually large size, and are always placed just below the aperture. The œcia (*œ.*) are remarkably small. They do not rise more than 3 or 4 mm. above the zœcium, while in many cases the embryo measures 10 mm. in length. Fig. 5 represents two embryos (*emb.*), which lie for the most part in the upper portion of the zœcia. In his description of *B. purpurotincta*, Mr. Hincks speaks of the extreme shallowness of the œcia, and says that they only partially cover the embryo in its later stages.

Whether these deviations from the type can be considered as mere individual variations or whether they have specific value is still an open question. Provisionally, at least, this form is placed in the present species. If upon further study it should prove to be new, I would suggest the name *Bugula pacifica*, since it seems to be characteristic of this coast.

BUGULA FLABELLATA J. V. Thompson.

Bugula flabellata HINCKS (80), pl. xi, figs. 1-3.

Bugula avicularia forma 2, *B. flabellata* SMITT ('67), pl. xviii, fig. 11.

Habitat.—On a limpet shell.

Local distribution.—Sitka, 10 fms.

Foreign distribution.—Britain; Heligoland; Ostend; Roscoff; Adriatic; Florida, deep water; Madeira; Cape of Good Hope.

Family *CELLARIIDÆ*.

CELLARIA Lamouroux.

CELLARIA BOREALIS Busk.

Cellaria borealis SMITT ('67), pl. xx, fig. 17.

Salicornaria borealis BUSK ('55), pl. I, figs. 1-3.

Habitat.—Abundant on rocks.

Local distribution.—Yakutat; Orca, Prince William Sound; Houston-Stewart Channel, Cumshewa Harbor, Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Greenland.

This fine species is very abundant at Orca, where it grows in thick masses three or four inches in height. The branching is very profuse in the younger portions of the colony. In the older portion, the first six or eight internodes form an articulated stem without lateral branching. At the point where it begins, three and sometimes four internodes arise from the distal end of one. Above this the branching is dichotomous, while the tallest internodes are tipped with three or four very small ones. The young, actively growing portion is conspicuous for its bright flesh-color, which causes it to stand out boldly against the dark background of rock.

Family *FLUSTRIDÆ*.

FLUSTRA Linnæus.

FLUSTRA LICHENOIDES sp. nov.

(Pl. XX, figs. 7, 7a, 8.)

Habitat.—Upon shells, worm tubes, ascidians, and upon the rocks at low tide.

Local distribution.—Yakutat; Orca, Prince William Sound; Puget Sound; Point Cavallo, California.

Zoarium unilaminar, consisting of broad, foliaceous fronds. Zœcia in alternate rows, arched above, narrowed below, the upper margin of the cell raised and armed on each side with three or four spines; the uppermost spine on each side stands upright and stiff, the other two or three are flattened and bend inward, the ends frequently meeting. Cœcia globose. Avicularia none. Radical fibers, by which the fronds are attached, growing from the under side of the zœcia.

The zoarium does not rise much above the substratum, but spreads out in convoluted masses. From the point of origin of a colony, smaller fronds spring, frequently overlapping the older ones, and the whole has much the appearance of a brown lichen. The radical fibers spring from the upper corner of the dorsal side of the zœcia (fig. 8, *r. f.*). These frequently anastomose and form a network by which the colony or frond is anchored. In some cases fibers from the dorsal surface of an overlapping frond attach themselves to the margin of the zœcia of the lower frond. Again, the laminæ are united back to back. They are easily separable, however, and their union is effected by means of short fibers. The margin of the distal part of the zœcium is much elevated and the spines are very prominent (fig. 7). There is considerable variation in their development, both in number and size. The two horn-like ones at the top are always present. Below these are usually two flattened ones on each side, which fold over the zœcium just below the ovicell (*f. sp.*). Sometimes, however, there are three flattened spines on each side, and again but one. Even on the same frond these variations in number are found, as well as considerable variation in size. No structure which could be called an avicularium has been detected, although a considerable quantity of material has been examined, both from Alaska and from Puget Sound.

Family MEMBRANIPORIDÆ.

MEMBRANIPORA Blainville.

MEMBRANIPORA LACROIXII Andouin.

Membranipora lacroixii HINCKS ('80), pl. xvii, figs. 5-8.

Biflustra lacroixii SMITT ('72), Flor. Bry. pt. 11, pl. iv, figs. 85-88.

Habitat.—On shell.

Local distribution.—Kadiak.

Foreign distribution.—Coasts of Britain; Mediterranean; coast of Florida, 13-60 fms.; St. Lawrence.

MEMBRANIPORA MEMBRANACEA Linnæus.

Membranipora membranacea HINCKS ('80), pl. xviii, figs. 5, 6.

Flustra membranacea JOHNSTON ('47), pl. LXVI, figs. 1-3.

Habitat.—Upon kelp forming circular patches.

Local distribution.—Yakutat; Pribilof Islands, Alaska; Queen Charlotte Islands, incrusting stem of a seaweed.

Foreign distribution.—Universally distributed on the coasts of Britain; Hvidingsoe; Hongesund; Roscoff; Adriatic; Lyalls Bay, New Zealand; Australia.

MEMBRANIPORA LINEATA Linnæus.

Membranipora lineata HINCKS ('80), pl. XIX, figs. 3-6.

Membranipora lineata SMITT ('67), pl. XX, fig. 23; Flor. Bry. pt. II, pl. II, fig. 62.

Habitat.—A small patch on *Cellaria borealis*.

Local distribution.—Orca, Prince William Sound.

Geographical distribution.—Common on the coasts of Britain; Roscoff; Scandinavia, in shallow water, common; Baltic; Spitzbergen; Davis Strait, 100 fms.; Iceland, 15-20 fms.; Nova Zembla; Kara Sea; South Labrador; Adriatic; Florida; New Zealand.

MEMBRANIPORA UNICORNIS Fleming.

Membranipora unicornis HINCKS ('80), pl. XX, fig. 4.

Membranipora lineata 5, forma *unicornis*, BB, stadium longius adultum SMITT ('67), pl. XX, fig. 30.

Habitat.—Upon other Bryozoa and on hydroid stems.

Local distribution.—Juneau; Yakutat; Orca; Houston-Stewart Channel, Queen Charlotte Islands.

Foreign distribution.—Britain; Bohuslän; Spitzbergen; Greenland; Nova Zembla.

MEMBRANIPORA SPINIFERA Johnston.

Membranipora spinifera HINCKS ('80), pl. XIX, figs. 1, a, b, c.

Habitat.—Upon a stone.

Local distribution.—Orca, Prince William Sound.

Foreign distribution.—Abundant upon the British coast, France.

MEMBRANIPORA SANDALIA sp. nov.

(Pl. XX, figs. 9, 9a, 9b; Pl. XXI, fig. 10.)

Habitat.—Upon sponge.

Local distribution.—Yakutat.

Zoarium forming a rather loose crust, brittle and delicate, and only partially attached; spreading out in a fan-shaped expansion, the gelatinous margin of which is often convoluted; the apposed surfaces often growing together and forming irregular ridges over the colony. Zæcia oblong, quadrangular in the younger stages, much narrowed below in the older, and disposed in alternate series. In the adult stage, the upper half of the zæcial front is occupied by a membranous area, containing the crescent-shaped orifice at its distal end. The lower half is traversed by a network of calcareous lines or ribs

which extend from the lateral margins and converge, either to a central line extending from the base of the zœcia or to the base of a raised portion of the zœcial wall just below the aperture. An avicularium is developed upon this raised portion, with mandible directed to one side. Cœcia ?

This species seems to afford a transition between the Flustridæ and the Membraniporidæ. It possesses flustrine characteristics in the shape of the zœcium in the younger stages, and in the free frond-like growth of part of the colony. Where it is attached, however, the mode of adherence is membraniporidan. The thickened rim of the zœcium grows fast to the substratum, and upon removal of the crust the oblong shape of the under surface is left in outline. The type of avicularia is that of *Membranipora*, as is also the secondary calcification of a portion of the front wall.

In a colony of moderate size, three stages of growth can easily be distinguished. Upon the growing edge the zœcia are but faintly outlined, and the aperture occupies the whole of the front (fig. 9*a*, *ap.*). This shape is retained through the next four or five rows, but the second stage begins in the calcification of the lower half of the zœcia and the strengthening of their lateral walls. Fig. 9*b* represents an early stage of calcification. This begins sometimes as fine lines proceeding from the side and basal walls (*l.*), sometimes as thickened growths resembling denticles (*d.*). Soon the future aperture is outlined by the formation of a calcareous rim which does not quite unite below it (fig. 9, *ap.*). Meanwhile the calcareous thickenings along the lateral (fig. 9, *lat.*) and basal (fig. 9, *bas.*) margins of the proximal end of the zœcia converge toward a smaller area (*ar.*), which is left uncalcified just below the aperture. The secondary thickenings gradually unite more or less, leaving quite wide spaces, or lacunæ between them, which are covered only by the membranous material of the original aperture. In the third stage, represented by Pl. XXI, fig. 10, a large sessile avicularium (*av.*) is present upon the area below the aperture. Calcification has continued, and the whole of the lower portion of the zœcium has become involved. It is now covered by a thin calcareous crust which slightly obscures the calcareous network previously formed, and covers the muscular portion of the avicularium with a delicate granular layer. The avicularium seems elevated upon a kind of mound, and possesses a pointed mandible directed slightly upward or in the direction of the rim of the aperture (fig. 10, *man.*). The mandible turns in some cases to the right, in others to the left. Cœcia are not known.

Family *CRIBRILINIDÆ*.

CRIBRILINA Gray.

CRIBRILINA ANNULATA Fabricius.

Cribrilina annulata HINCKS ('80), pl. xxv, figs. 11, 12.

Escharipora annulata SMITT ('67), pl. xxiv, figs. 8-10.

Habitat.—A small colony growing upon an ascidian.

Local distribution.—Yakutat.

Foreign distribution.—Britain; Greenland; Nova Zembla; Kara Sea; Hammerfest; Spitzbergen, 3-30 fms.; Bergen; Labrador; Grand Menan, Bay of Fundy; Gulf of St. Lawrence.

Family *MYRIOZOIDÆ*.

SCHIZOPORELLA Hincks.

SCHIZOPORELLA BIAPERTA Michelin.

Schizoporella biaperta HINCKS ('80), pl. xl, figs. 7-9.

Escharella linearis forma *biaperta* SMITT ('67), pl. xxiv, figs. 70, 73.

Hippothoa biaperta SMITT ('72), pl. viii, figs. 173-176.

Habitat.—On shells of brachiopods.

Local distribution.—Juneau; Houston-Stewart Channel; Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Spitzbergen; Greenland; Kara Sea; Florida.

SCHIZOPORELLA HYALINA Linnæus.

Schizoporella hyalina HINCKS ('80), pl. xviii, figs. 8-10.

Mollia hyalina SMITT ('67), pl. xxv, fig. 84.

Habitat.—On shells and on other Bryozoa.

Local distribution.—Sitka; Juneau; Orca; Yakutat; Houston-Stewart Channel; Virago Sound; Fort Point and Santa Cruz, California.

Foreign distribution.—Arctic seas; Spitzbergen; Greenland; Mediterranean; Africa; Australia.

SCHIZOPORELLA INSCULPTA Hincks.

Schizoporella insculpta HINCKS ('83), pl. xvii, fig. 5.

Habitat.—On *Alcyonidium mytili*.

Local distribution.—Sitka, both in the littoral region, and dredged at 10 fms.; Virago Sound, Cumshewa Harbor, Queen Charlotte Islands; Vancouver Island; Alki Point, Puget Sound.

MYRIOZOOM Donati.**MYRIOZOOM COARCTATUM** Sars.

Myriozoom coarctatum SMITT ('67), pl. xxv, fig. 92.

Local distribution.—Juneau; Orca; Yakutat; Cumsheewa Harbor, Houston-Stewart Channel, Queen Charlotte Islands.

Foreign distribution.—Norway; Finmark; Hammerfest; Komag-fyord.

MYRIOZOOM CRUSTACEUM Smitt.

Myriozoom crustaceum SMITT ('67), pl. xxv, figs. 88–91.

Habitat.—Incrusting ascidians, shells, and *M. coarctatum*. Abundant.

Local distribution.—Juneau; Orca; Yakutat; Kadiak.

Geographical distribution.—Common in the Arctic regions; Finmark; Spitzbergen; East Greenland.

Family **ESCHARIDÆ**.**LEPRALIA** Johnston.**LEPRALIA FOLIACEA** Ellis & Solander.

Lepralia foliacea HINCKS ('80), pl. XLVII, figs. 1–4.

Local distribution.—Juneau.

Foreign distribution.—Southern coasts of Britain; Hebrides, most northern locality; Mediterranean; Adriatic; Algiers; Roscoff; Naples; Cape of Good Hope; Indian Ocean.

SMITTIA Hincks.**SMITTIA TRISPINOSA** Johnston.

Smittia trispinosa HINCKS ('80), pl. XLIX, figs. 1–8.

Escharella jacotini SMITT ('67), pl. XXIV, figs. 53–57.

Habitat.—On shell and stone.

Local distribution.—Sitka; Juneau; Houston-Stewart Channel, Cumsheewa Harbor, Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Common on the coast of Britain; Norway; Arctic seas; Gulf of St. Lawrence; Florida; Mazatlan; Cape Horn; Aden; Adriatic; East Indies; Bass Straits.

Family **CELLEPORIDÆ**.**CELLEPORA** (part) Fabricius.**CELLEPORA INCRASSATA** Lamarck.

Habitat.—Incrusting *Cellaria borealis*. The branched form also found.

Local distribution.—Juneau; Berg Inlet; Orca; Pribilof Islands; Houston-Stewart Channel, Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Finmark; Spitzbergen; Greenland; Bank of Newfoundland.

Suborder *CYCLOSTOMATA* Busk.

Family *CRISIIDÆ*.

CRISIA (part) Lamouroux.

CRISIA CORNUTA Linnæus.

Crisia cornuta (a : sine cornibus) SMITT ('65), pl. xvi, figs. 2, 3.

Crisia geniculata HARMER ('91), pl. xii, figs. 7, 8.

Habitat.—Upon shells and other Bryozoa.

Local distribution.—Sitka; Juneau; Yakutat; Orca.

Foreign distribution.—Britain; Roscoff; Mediterranean; Bahusia; Norway.

Family *TUBULIPORIDÆ*.

ENTALOPHORA Lamouroux.

ENTALOPHORA CAPITATA sp. nov.

(Pl. XXI, figs. 11, 12, 13.)

Habitat.—Upon stems and roots of hydroids.

Local distribution.—Sitka; Juneau, 10 fms.

Zoarium consisting of a number of zœcia arising from a flattened or incrusting base, many of them uniting to form one or more short columns which terminate in a rounded head. Zœcia tubular, distal ends free; those forming the column opening upon all sides of it. The surface of the head composed of the orifices pressed close together, or projecting slightly through the granular matrix, which is perforated by rather large pores.

This species was obtained in two slightly different forms whose main features, however, are similar. Figs. 11 and 12 represent them of natural size. The one in fig. 11 was dredged in 10 fms., and is a deep purple color. The base is elliptical. The zœcia on the periphery are decumbent, while those in the center are almost upright, their tubular orifices projecting somewhat beyond the granular matrix in which they are imbedded. At each end of the long diameter of the base a number of zœcia have united to form a column. The smaller of these is represented, somewhat enlarged, by fig. 13. Here the column arises out of a forest of tubes so that its base is somewhat

obscured. The top spreads out into a rounded head whose diameter is greater than that of the stalk. Upon the surface the orifices are, for the most part, closely approximated and assume a hexagonal shape. A very few project slightly and are circular. The transition from the top of the column into the mound-like surface is not definitely marked by any border or rim such as is shown for *Stomatopora fungia* (Hincks '80) or for *Tubulipora pencillata* (Smitt '66). The second form, represented of natural size in fig. 12, is white in color, and was obtained at low tide, partially incrusting a hydroid stem. In this case the colony has attached itself by encircling the stem in an irregular way, and has formed a column terminated by the mound-like head.

Family *LICHENOPORIDÆ*.

LICHENOPORA DeFrance.

LICHENOPORA VERRUCARIA Fabricius.

Lichenopora verrucaria HINCKS ('80), pl. LXIV, figs. 4, 5.

Habitat.—Upon *Cellaria borealis*.

Local distribution.—Orca; Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Bahusia; Norway; Finmark; Arctic seas; Bay of Fundy; St. George Banks; Britain, north and west.

Suborder *CTENOSTOMATA* Busk.

Family *ALCYONIDIIDÆ*.

ALCYONIDIUM Lamouroux.

ALCYONIDIUM GELATINOSUM Linnæus.

Alcyonidium gelatinosum HINCKS ('80), pl. LXIX, figs. 1-3.

Halodactylus diaphanus FARRE ('37), pls. XXV, XXVI, figs. 1-16.

Local distribution.—Muir Inlet; Orca; Garforth Island; Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Coasts of Britain; Norway; Sweden; North America; White Sea; Nova Zembla; Kara Sea; Natal.

ALCYONIDIUM MYTILI Dalyell.

Alcyonidium mytili HINCKS ('80), pl. LXX, figs. 2, 3.

Alcyonidium parasiticum SMITT ('65), pl. v, figs. 8-19.

Habitat.—Growing on ascidians, shell, and on *Fucus*.

Local distribution.—Sitka; Yakutat; Fakir Islet; Garforth Island.

Foreign distribution.—Bahusia, 5-20 fms.; Baltic Sea; coasts of Britain.

ALCYONIDIUM POLYOUM Hassall.

Alcyonidium polyum HINCKS ('80), pl. LXIX, fig. 9.

Sarchochitum polyum JOHNSTON ('47), pl. LXXI, fig. 1.

Habitat.—On stones, kelp, and on hydroid stems.

Local distribution.—Orca, Prince William Sound; Yakutat.

Foreign distribution.—Dublin Bay; Northumberland; Roscoff.

The species which I have identified as *A. polyum* forms circular colonies an inch or more in diameter. In its young state only, can it be described as forming a thin crust. At that stage the boundaries of the zœcia are distinctly marked off, and it resembles *A. mytili* very closely. It may be distinguished, however, by the position of the zœcia and by the orifice. The zœcia toward the center tend to become upright, and those on the periphery are partially raised, so that the upper portion projects from a gelatinous matrix. They are rounded or barrel-shaped, and the orifice opens upon a distinct papilla. The orifice contains a great number of black setæ, some of which project quite far beyond it even when it is closed. The primary crust is quite transparent, but soon thickens into a somewhat fleshy mass of a dark brown color.

ALCYONIDIUM CERVICORNIS sp. nov.

(Pl. XXI, figs. 14, 15, 16, 17.)

Habitat.—On seaweed and on *Cellaria borealis*.

Local distribution.—Orca and Juneau.

Zoarium consisting of a rounded ball-like mass of a dark-brown color. Zœcia imbedded in the gelatinous mass, the orifices projecting above the surface. The surface bristling with tall, red, branching, hollow spines which project from spaces between the zœcia.

The distinguishing mark of this species consists in the great number of hollow branching spines which beset the surface. Figure 14 is a habit sketch, natural size, of a colony. Fig. 15 represents a portion of the surface showing a number of the spines and the projecting orifices (*or.*) of the zœcia. The spines arise from definite portions of the surface, between the zœcia. They are hollow and the interior contains a stainable tissue which extends to the tips of the branches. Each spine consists of a central stem which forks at the top into four branches or prongs. Fig. 16 represents the branches viewed from above. Sometimes the tips of the prongs divide, as represented by fig. 17, and the resemblance to antlers is very marked. In other respects this species bears a resemblance to *A. polyum*.

The colony is gelatinous and composed of but one layer, and the polypides, which are inclined somewhat to the surface, lie imbedded in the matrix. The orifices are circular and open upon distinct papillæ.

Family *FLUSTRELLIDÆ*.

FLUSTRELLA Gray.

FLUSTRELLA HISPIDA Fabricius.

Flustrella hispida HINCKS ('80), pl. LXXII, figs. 1-5.

Flustrella hispida JOHNSTON ('47), pl. LXVI, fig. 5.

Local distribution.—Yakutat, forming branching masses; Lands End; Fort Point, California.

Foreign distribution.—Common in Britain; Bahusia; Finmark; Greenland; Heligoland; Roscoff; France.

Family *VESICULARIIDÆ*.

BOWERBANKIA Farre.

BOWERBANKIA IMBRICATA Adams.

Bowerbankia imbricata HINCKS ('80), pl. LXXIII, figs. 1, 2.

Bowerbankia densa FARRE ('37), pl. XX and XXI, figs. 1-16.

Habitat.—Creeping over other Bryozoa.

Local distribution.—Orca; Yakutat; Lime Point, California; Virago Sound, Queen Charlotte Islands.

Foreign distribution.—Common on the coast of Britain; White Sea; Caspian Sea; Ostend; Roscoff.

Suborder *PHYLACTOLÆMATA* Allman.

Family *PLUMATELLIDÆ*.

PLUMATELLA Lamarck.

PLUMATELLA REPENS Linnæus.

Plumatella repens ALLMAN ('56), pl. v, figs. 1-8.

Plumatella repens JOHNSTON ('47), 2d ed., p. 403, fig. 76.

Local distribution.—Water-lily pond at Kadiak; Lake Washington, Seattle; Mountain Lake, San Francisco.

Foreign distribution.—Through Great Britain; Lake Lucerne; Lake Como; Alpine lakes; lakes in the Pyrenees; France; Italy; Germany; Prussia; Sweden; Denmark.

Group *ENTOPROCTA* Nitsche.Family *PEDICELLINIDÆ*.*PEDICELLINA* Sars.*PEDICELLINA NUTANS* (?) Ballyell.

Pedicellina nutans HINCKS ('80), p. 569, woodcut figs. 37, 38, 40.

Habitat.—On roots of hydroids and Bryozoa.

Local distribution.—Yakutat; Tomales Bay, California.

Foreign distribution.—Coast of England.

This form is placed here provisionally. It conforms in general with the diagnoses of Hincks and of Ehlers ('90). Tentacles possess one characteristic, however, which is not mentioned by these writers. They contain a yellowish-brown pigment which is very conspicuous, at least after the animal is killed, and which is very persistent. It is not destroyed even when the tissue is treated with the reagents necessary for imbedding and staining. It seems to be lodged in the outer layer of cells of the tentacles, and is not found in the lophophore nor in any other part of the animal, so far as I have been able to observe.

LIST OF SPECIES.

CHEILOSTOMATA.

Gemellaria loricata.

Menipea ternata.

Menipea ternata forma *gracilis*.

Menipea erecta sp. nov.

Scrupocellaria scabra.

Caberea ellisii.

Bugula murrayana.

Bugula purpurotincta.

Bugula flabellata.

Cellaria borealis.

Flustra lichenoides sp. nov.

Membranipora lacroixii.

Membranipora membranacea.

Membranipora lineata.

Membranipora unicornis.

Membranipora spinifera.

Membranipora sandalia sp. nov.

Cribrilina annulata.

Schizoporella biaperta.

Schizoporella hyalina.

Schizoporella insculpta.

Myrionozoum coarctatum.

Myrionozoum crustaceum.

Leprosia foliacea.

Smittia trispinosa.

Cellepora incrassata.

CYCLOSTOMATA.

Crisia cornuta.

Entalophora capitata.

Lichenopora verrucaria.

CTENOSTOMATA.

- | | |
|---------------------------------|---|
| <i>Alcyonidium gelatinosum.</i> | <i>Alcyonidium cervicornis</i> sp. nov. |
| <i>Alcyonidium mytili.</i> | <i>Flustrella hispida.</i> |
| <i>Alcyonidium polyoum.</i> | <i>Bowerbankia imbricata.</i> |

PHYLACTOLÆMATA.

Plumatella repens.

ENTOPROCTA.

Pedicellina nutans (?).

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ABBREVIATIONS USED IN THE FIGURES.

- av.*—avicularium.
ar.—area.
art.—articulation.
ap.—aperture.
b.—beak.
bas.—basal.
bifur.—bifurcation of branch.
d.—denticle.
emb.—embryo.
f. a.—frontal avicularium.
fl. sp.—flattened spine.
l.—lines of calcification.
lat.—lateral.
m.—margin.
man.—mandible.
mus. app.—muscular apparatus.
æ.—æcium.
op.—operculum.
or.—orifice.
ped.—peduncle.
r. f.—radical fiber.
sp.—spine.
zæ.—zæcium.

PLATE XXIII.

[Proc. Wash. Acad. Sci., Vol. II, Pl. XIX.]

(All figures drawn by aid of a camera lucida except 7*a*, 11, 12, and 13.)

- FIG. 1. *Menipea erecta* sp. nov. Frontal view, showing bifurcation of an internode and main points of structure; spine (*sp.*), operculum (*op.*), frontal avicularia (*f. a.*), æcia (*æ.*), and mode of articulation (*art.*).
2. Dorsal view of the same, showing the radical fibers (*r. f.*) and the place of their attachment upon the zœcia.
3. *Scrupocellaria scabra* Van Beneden, frontal view.
4. Dorsal view of the same, showing absence of vibracula.

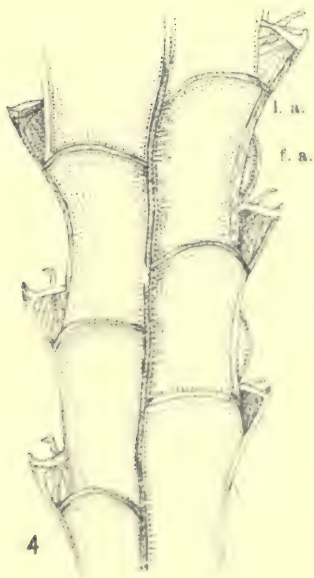
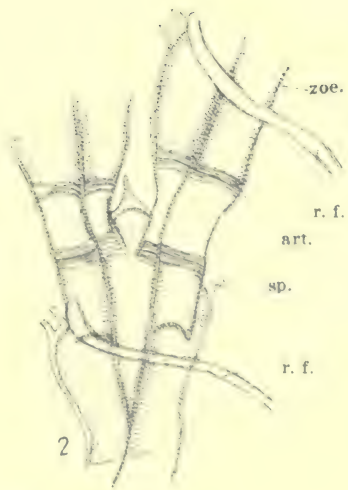
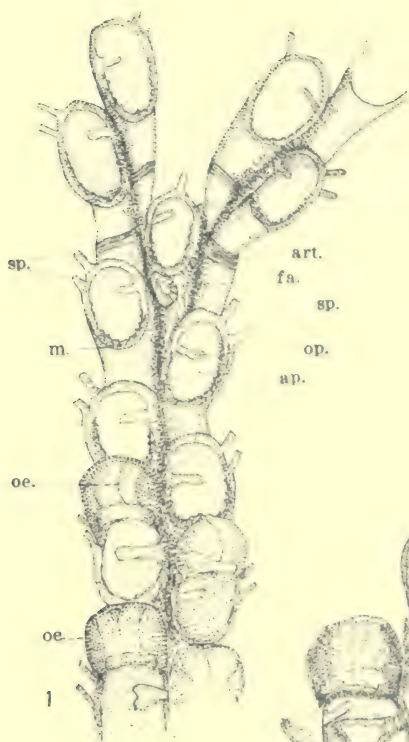


PLATE XXIV.

[Proc. Wash. Acad. Sci., Vol. II, Pl. XX.]

- FIG. 5. *Bugula purpurotincta* Norman, frontal view. The two lower zœcia on the left show the small size of the œcia (*æ.*) compared with that of the embryo (*emb.*) (*av.*) avicularium.
- 5a. An avicularium which had broken away from its zœcium; peduncle (*ped.*), mandible (*man.*), beak (*b.*), muscular apparatus (*mus. app.*).
6. Dorsal view of the same, showing spine (*sp.*) and avicularium (*av.*) as seen from the back, and the mode of bifurcation (*bifur.*).
7. *Flustra lichenoides* sp. nov. Frontal view, showing œcia (*æ.*) and variation in the number of flattened spines (*fl. sp.*).
- 7a. A single frond of the same, natural size.
8. Dorsal surface of the same, showing the radical fibers (*r. f.*) and their mode of attachment to the zœcia.
9. *Membranipora sandalia* sp. nov. Upper surface, representing a few zœcia in the second stage. The aperture (*ap.*) occupies the distal end of the zœcium. Below it is the uncalcified area (*ar.*) upon which an avicularium will be formed, and toward which the calcareous thickenings converge.
- 9a. One zœcium of the same near the edge of the colony. It is oblong in shape and the aperture (*ap.*) occupies the whole of the front.
- 9b. A zœcium of the same, showing the beginnings of calcification (*l.*) and (*d.*). The future aperture (*ap.*) is already laid off.

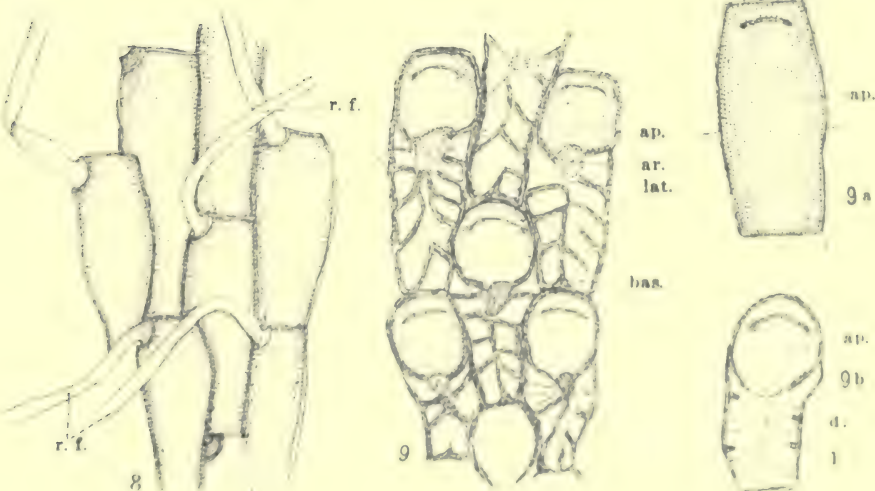
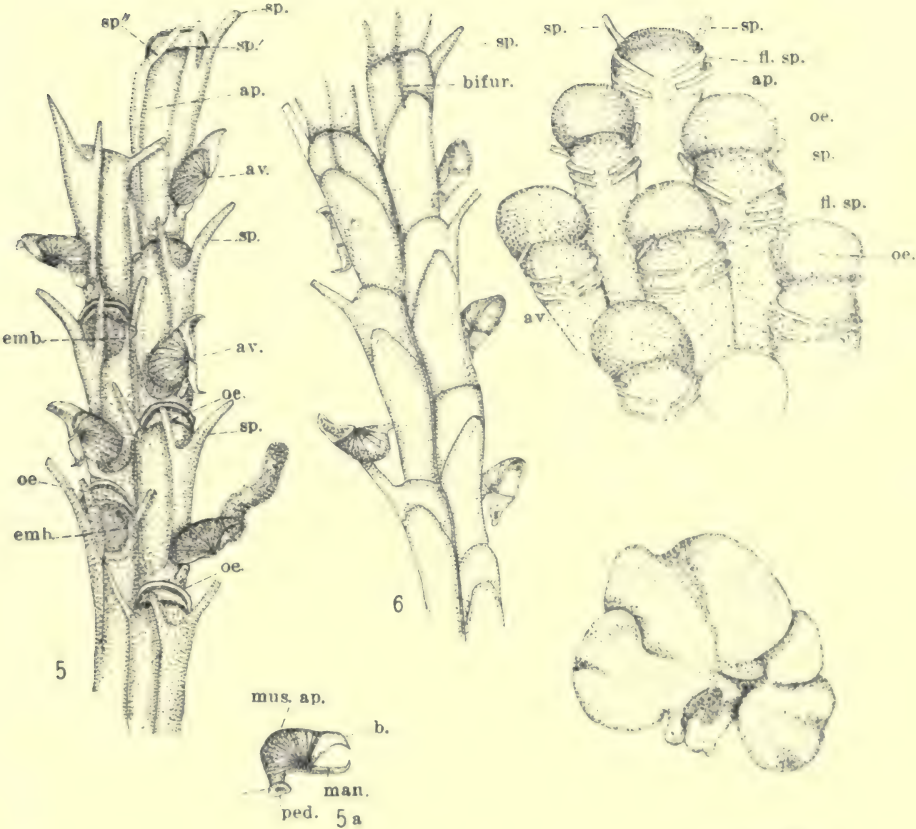
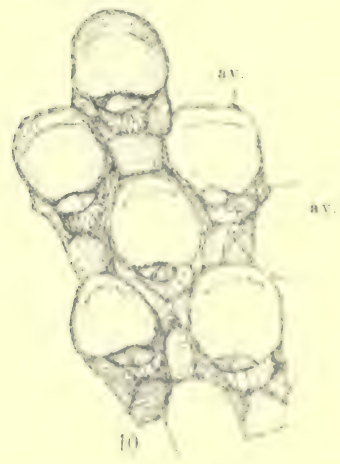
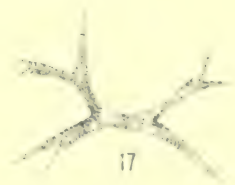
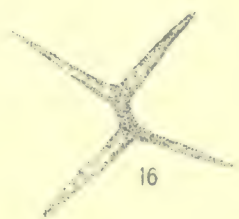


PLATE XXV.

[Proc. Wash. Acad. Sci., Vol. II, Pl. XXI.]

- FIG. 10. The adult stage of *Membranipora sandalia*, in which the surface is covered with a fine calcareous layer, obscuring the network previously formed. A large sessile avicularium (*av.*) is found upon the area below the aperture.
11. *Entalophora capitata* sp. nov. Natural size of the purple variety with elliptical base. Orifices of the upright zœcia (*or.*).
12. The white variety of the same, natural size.
13. The smaller of the two columns represented by fig. 11. Only part of the base (*bas*) shown in the drawing.
14. *Alcyonidium cervicornis* sp. nov. A colony, natural size.
15. Part of the surface of the same, showing spines, and orifices of the zœcia (*or.*).
- FIGS. 16 and 17. Two of the spines of the same, showing two modes of branching. The drawing is intended to show the branching top of the spine as it appears when viewed directly from above.



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